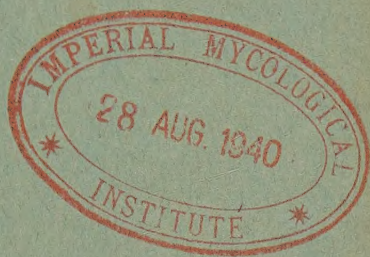


THE
Tea Research Institute
OF
Ceylon.



BULLETIN No. 21

Annual Report for the Year
1939.



Published by
THE TEA RESEARCH INSTITUTE OF CEYLON,
ST. COOMBS, TALAWAKELLE.

The Tea Research Institute of Ceylon.

SCIENTIFIC STAFF.

Director	...	Roland V. Norris, D.Sc. (Lond.), M.Sc. (Manc.) F.I.C.
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Department of Mycology

Mycologist	...	C. H. Gadd, D.Sc. (Birm.)
Assistant Mycologist	...	T. E. T. Bond, Ph.D. (Cantab), M.Sc.
Assistant	...	C. A. Loos. (Reading).

Department of Agricultural Chemistry.

Agricultural Chemist	...	T. Eden, D.Sc. (Manc.), A.I.C.
Research Assistant	...	J. G. Shrikhande, Ph.D. (Lond.), M.Sc. (Nagpur), A.I.C.
Assistant	...	E. N. Perera
Field Assistants	...	M. Piyasena
	...	B. T. Schuiling

Department of Biochemistry.

Biochemist	...	J. Lamb, M.Sc. (Lond.), A.I.C., A.I.C.T.A.
Research Assistant	...	H. B. Sreerangachar, M.Sc. (Bombay), B.Sc. (Mysore), A.I.C., A.I.I.Sc.
Assistants	...	V. Mendis
	...	E. L. Keegel
	...	P. R. Perera

Department of Entomology.

Entomologist	...	C. B. Redman King, M.A. (Cantab.) M.C.
Assistant Entomologist	...	G. D. Austin
Assistant	...	D. J. William
Field Assistant	...	W. T. Fonseka

Department of Plant Physiology.

Plant Physiologist	...	F. R. Tubbs, Ph.D. (Lond.), D.I.C., A.R.C.S.,
Assistant	...	M. H. E. Koch (F.L.S.)
Field Assistants	...	F. H. Kehl
	...	F. P. Jayawardana

Small-Holdings Officers.

	...	R. L. Illankoon
	...	F. D. Tillekeratne

Superintendent, St. Coombs Estate	...	J. A. Rogers
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NOTE.

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address :—Research, Talawakelle; Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name.

FOURTEENTH ANNUAL REPORT

OF THE

BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON

FOR 1939.

Foundation.—The Tea Research Institute of Ceylon was established by Ordinance No. 12 of 1925, dated the 27th October, 1925.

Past Chairmen of the Institute.

Name	Date of Appointment		Date of Resignation	
Major J. W. Oldfield, C.M.G., O.B.E., M.C.	7th January,	1926.	24th November,	1926.
Mr. John Horsfall	24th November,	1926.	14th April,	1927.
Mr. R. G. Coombe	14th April,	1927.	9th April,	1929.
Major J. W. Oldfield C.M.G., O.B.E., M.C.	9th April,	1929.	30th September,	1929.
Mr. C. H. Wilkinson	30th September,	1929.	28th November,	1929.
Mr. R. G. Coombe	29th November,	1929.	7th April,	1932.
Mr. G. K. Stewart	7th April,	1932.	26th November,	1932.
Mr. R. G. Coombe	26th November,	1932.	13th January,	1934.
Mr. James Forbes	13th January,	1934.	31st October,	1936.
Mr. R. G. Coombe	31st October,	1936.	2nd June,	1937.
Mr. James Forbes	2nd June,	1937.		

BOARD OF MANAGEMENT.

The Constitution of the Board is laid down in the Ordinance; the personnel on the 1st day of January, 1939, was :—

Ex-Officio Members.

- The Hon'ble the Financial Secretary (Hon. Mr. H. J. Huxham).
- The Director of Agriculture (Mr. E. Rodrigo).
- The Chairman, Planters' Association of Ceylon (Mr. R. C. Scott).
- The Chairman, Ceylon Estates Proprietary Association (Mr. R. J. Hartley).

Representatives of the Planters' Association of Ceylon.

Mr. James Forbes (Chairman).

Mr. R. G. Coombe

Mr. J. D. Hoare.

Representatives of the Ceylon Estates Proprietary Association.

Major J. W. Oldfield, C.M.G., O.B.E., M.C.

Mr. I. L. Cameron.

Mr. J. C. Kelly.

Representative of the Low-Country Products Association.

Mr. S. F. H. Perera.

Representative of the Small-Holders.

Mr. T. B. Panabokke, Adigar.

Chairman.—Mr. James Forbes.

Secretary.—Dr. Roland V. Norris.

Solicitors.—Messrs. Julius & Creasy.

Auditors.—Messrs. Ford, Rhodes, Thornton & Co.

Registered Office.—The Victoria Commemoration Buildings, Kandy.

The Chairman, T.R.I.—Mr. James Forbes was the Chairman of the Board throughout the year.

Members of the Board.—Mr. Gordon Pyper was nominated by the Planters' Association of Ceylon to act for Mr. R. G. Coombe during the absence of the latter on leave from 31st January to 13th October.

Mr. I. L. Cameron was renominated by the Ceylon Estates Proprietary Association to serve as their representative on the Board for a further period of 3 years as from 27th January.

Mr. C. H. Bois on his election to the Chairmanship of the Ceylon Estates Proprietary Association became an *ex-officio* member of the Board as from the 20th April, *vice* Mr. R. J. Hartley vacated.

Mr. R. Gregor was nominated by the Planters' Association of Ceylon to act for Mr. J. D. Hoare during the absence on leave of the latter as from the 17th November.

Mr. C. M. W. Davies, as Acting Chairman of the Planters' Association of Ceylon, served as an *ex-officio* member of the Board during the absence on leave of Mr. R. C. Scott.

MEETINGS OF THE BOARD.

Four meetings of the Board were held during the year, all in Colombo, the average attendance being 10.

AUDITORS.

Messrs. Ford, Rhodes, Thornton & Co. continued to act as the Institute's Auditors.

COMMITTEES.

The following were the principal Committees in 1939:—

Finance Committee.—The Chairman, T.R.I., the Chairman, Planters' Association of Ceylon, the Chairman, Ceylon Estates Proprietary Association, Major J. W. Oldfield, C.M.G., O.B.E., M.C., Mr. J. D. Hoare, Mr. J. C. Kelly, and the Director, T.R.I.

Mr. R. Gregor acted for Mr. J. D. Hoare during the latter's absence on leave as from 17th November.

Estate and Experimental Sub-Committee.—The Director, T.R.I. (Chairman), the Chairman, T.R.I., the Visiting Agent (Mr. H. Tonks), the Superintendent, St. Coombs, Messrs. R. G. Coombe, C. H. Wilkinson, D. T. Richards, R. H. Horne, J. T. Young, F. J. Whitehead and Dr. F. R. Tubbs (Secretary).

Mr. C. H. Wilkinson resigned from the Committee on his retirement from Ceylon.

Mr. Gordon K. Newton was appointed to serve on the Committee as from 13th October.

Mr. J. D. Hoare acted for Mr. R. G. Coombe during the latter's absence on leave from 31st January to 13th October.

Dr. F. R. Tubbs resigned his post as Convener on his departure from Ceylon on home leave as from 1st March and his place was taken by Dr. T. Eden.

Mr. T. Kane acted for Mr. R. H. Horne during the latter's absence on leave.

This Committee held three meetings during the year.

Medical Scheme Sub-Committee.—The Chairman, T.R.I., the Director, T.R.I., and Mr. G. D. Austin, (representing the Junior Staff).

Trustees of the Junior Staff Provident Fund.—The Chairman, T.R.I., the Director, T.R.I., Mr. R. G. Coombe, and Mr. E. N. Perera (representing the Junior Staff).

Mr. J. C. Kelly acted for Mr. R. G. Coombe during the latter's absence on leave from 31st January to 13th October.

Visiting Agent.—Mr. H. Tonks continued as Visiting Agent and paid two visits of inspection to St. Coombs Estate during the year.

FINANCE.

The total receipts for the year amounted to Rs. 359,595/- made up as follows : Cess Rs. 318,871/-, Profit on Estate Working Account Rs. 36,399/- and Interest and Miscellaneous Receipts Rs. 4,325/-.

Expenditure on Revenue Account, including Research Revenue Expenditure at Rs. 234,121/-, Depreciation at Rs. 38,719/-, and Interest Charges on the Government Loan at Rs. 41,115/-, amounted to Rs. 313,955/-. There was, therefore, a surplus on Revenue Account for the year amounting to Rs. 45,640.

Capital expenditure to the extent of Rs. 66,383/- was incurred, this sum comprising Rs. 32,647/- capital expenditure on assets, and Rs. 33,736/- representing repayment of the Government Loan.

Liquid assets as at 31st December, 1939, after providing for specific liabilities such as accrued interest on the Government Loan, and Furlough and Passages Reserve, amounted to Rs. 215,678/-, equivalent to 60.2 per cent. of the liability under the Depreciation Reserve which at the same date amounted to Rs. 358,183/-.

An application for a grant from the Colonial Development Fund to meet part of the cost of work on Phloem necrosis was submitted to the Ceylon Government for transmission to the authorities concerned.

ST. COOMBS ESTATE.

Weather conditions were very unfavourable during several months of the year. A severe drought in the period January to March, together with frost in February, not only retarded flush but delayed the return to plucking of fields pruned late in 1938, with the result that the crop figures at the end of April were more than 27,000 lbs. below estimate. Favourable conditions in May reduced this deficit by 14,000 lbs. but rough and exceptionally windy weather in August again reduced crop and the final yield of tea was only 151,929 lbs. against an estimate of 185,000 lbs.

38,553 lbs. of tea were supplied to Government under the short term contract. Of this 33,285 lbs. were taken by the Food Controller, Colombo, realising 82.41 cts. per pound, and one invoice of 5,268 lbs. was taken over in London by the Minister for Food, selling for 91.50 cents per pound.

Two experimental invoices, comprising 11,547 pounds, were sold in London at 98.60 cents per pound, and the balance of the crop was sold on the Colombo Market at an average price of 83.57 cents. The average price obtained for the whole crop was 84.74 cents as against 80.29 cents obtained in 1938.

The higher price obtained to some extent offset the shortfall in crop and the profit on Estate Working Account, as already mentioned, amounted to Rs. 36,399 against an estimate of Rs. 40,000.

Favourable inspection reports were received on the Estate School, and a grant amounting to Rs. 532/- was obtained from Government.

PUBLICATIONS.

The Institute's publications are sent free of charge to Proprietors, Directors, Superintendents and Assistant Superintendents of all Ceylon Tea Estates of over 10 acres in extent and to London and Colombo Agency Firms dealing with tea if they register their names with the Secretary.

Other persons can obtain the publications on payment of an annual subscription of Rs. 15/- per annum if resident in Ceylon or India, and £1-5-0 if resident elsewhere.

Single numbers of *The Tea Quarterly* or Bulletins can be obtained for Rs. 2-50 or 4 shillings per copy.

The average distribution during 1939 amounted to 1,800 copies.

The sum of Rs. 4,197 was received in subscriptions and Rs. 3,060 from advertisements; as a result of which there was a profit on publications of Rs. 3,125/-.

The following publications were issued during the year :—

The Tea Quarterly, Vol. XII, Parts I—IV.

Bulletin No. 19, Annual Report for 1938.

In addition a general index to the Institute's publications was prepared and sent to press at the end of the year.

ACKNOWLEDGMENTS.

Close co-operation has been maintained as usual with the Ceylon Association in London, the Ceylon Estates Proprietary Association, the Planters' Association of Ceylon, and other bodies concerned in the Tea Industry and the thanks of the Institute are due to these Associations for assistance and support in various matters.

The following gentlemen kindly acted as a Selection Committee in London in regard to the appointment of the Phloem necrosis research officer : Sir Frank Stockdale, Sir Edwin Butler, Professor F. L. Engledow, and Sir E. John Russell.

Thanks are due to the Ceylon Chamber of Commerce, Colombo, for the use of their Board room for meetings of the Board held in Colombo.

The audited Statement of Accounts and Balance Sheet for 1939 are attached, together with the reports of the Director and Scientific Staff on the research activities of the Institute.

ROLAND V. NORRIS.

Secretary.

THE TEA RESEARCH INSTITUTE OF CEYLON.

BALANCE SHEET AS AT 31st DECEMBER, 1939.

LIABILITIES		ASSETS	
	Rs. Cts.	Rs. Cts.	Rs. Cts.
CREDITORS & CREDIT BALANCES:—			
Accrued Interest on Loan	9,930.96	DEBTORS & DEBIT BALANCES:—	
Sundry Creditors—Research	3,700.59	Controller of Finance & Supply	31,934.20
Sundry Creditors—Estate	6,777.57	Cash paid in by Director	225.00
Subscriptions for Publications received in advance	52.45	Suspense	60
		Interest on £ 2,300/- 3½%	
		War Loan £ 40.50	534.81
FURLOUGH RESERVE:—		Refund due on Mr. J. Rogers' unutilised portion of Passage Money £ 30.16.0	410.67
At 31st December, 1938	15,739.78		33,105.28
Additions during 1939	6,621.00		
	22,360.78	SUNDRIES—RESEARCH:—	Rs. Cts
<i>Deduct: Payments during 1939.</i>	18,939.49	Research Staff	2,016.60
		Ceylon Association	
		in London £ 109.15.0	1,463.33
DEPRECIATION RESERVE:—		Sundry Debtors	
At 31st December, 1938	319,114.87	A/c Advertising	805.00
Amount realised on sale of Drier Chamber	350.00	Accrued Interest on	
		Fixed Deposits	521.76
	319,464.87		4,806.69
Credited at 31st December, 1939	38,718.62	SUNDRIES—ESTATE	
			2,329.55
		STOCKS-IN-HAND	
		Tea 29,027 lbs.	25,294.13
		Estate Rice	3,587.28
		Packing Materials	3,222.00
		INVESTMENTS (AT COST):	
		£ 2,300.0.0, 3½% War Loan	32,434.76
		£ 2,063.18.1.4, % Funding Loan]	29,928.06
		Rs. 30,000/- 3½% Ceylon Government Loan	29,512.50
Carried forward	Rs. 382,066.35	Carried forward	Rs. 164,220.25

THE TEA RESEARCH INSTITUTE OF CEYLON.

BALANCE SHEET AS AT 31st DECEMBER, 1939.—(Contd.)

LIABILITIES		ASSETS	
Rs.	Cts.	Rs.	Cts.
Brought forward	382,066-35		164,220-25
CASH :—			
Research Fixed Deposit		29,060-00	
Current Account		41,943-41	
In Hand		161-45	71,164-86
Estate—N.B.I. Ltd., Colombo		6,305-98	
"		19-50	77,490-34
FUNDS OVERSENT TO			
31st December, 1938.		...	119,612-64
Capital Expenditure 1939		...	32,646-85
Repayment of Govt. Loan 1939			33,736-38
			185,995-87
Less : Revenue applied for			
Capital purposes, being Revenue			140,355-76
Account Surplus for the year 1939		45,640-11	

Rs. 382,066 35

Rs. 382,066 35

We have audited the books of the Tea Research Institute of Ceylon for the year ended 31st December, 1939.

The allocations of Capital Expenditure and of Research Revenue Expenditure as made by the Director have been accepted by us.

We are not in a position to say whether the Reserves made for Depreciation are adequate.

Subject to the foregoing reservation, we certify that, to the best of our belief, the above Balance Sheet presents a true and correct view of the financial affairs of the Institute at 31st December, 1939, according to the information and explanations given to us and as shown by the books.

Colombo, 13th March, 1940.

FORD, RHODES, THORNTON & CO.,

Chartered Accountants.

THE TEA RESEARCH INSTITUTE OF CEYLON.

Dr.	CAPITAL ACCOUNT AS AT 31st DECEMBER, 1939.				Cr.	
	EXPENDITURE				RECEIPTS	
	To Rs. Cts.	Additions in 1939 Rs. Cts.	Deduct Amounts written off Rs. Cts.	Deduct cost of Assets sold or scrapped or transferred in 1939 Rs. Cts.	Total Rs. Cts.	
To LAND INCLUDING DEVELOPMENT	827,917-17	13,805-15	—	—	841,722-32	By GOVERNMENT OF CEYLON:— Loan on Mortgage at 5½% per annum 1,000,000-00
" BUILDINGS AND LINES	894,815-47	13,115-27	106-23	3,123-85	904,700-66	Less: Repayments to 31-12-38 244,011-88 Payment 1939 33,736-38 277,748-26 722,251-74
" FURNITURE AND EQUIPMENT	78,220-06	4,785-81	—	1,563-92	81,441-95	" REVENUE APPLIED FOR CAPITAL PURPOSES TO 31-12-38 1,131,880-72 DO 31-12-39 45,640-11 1,177,520-83
" LABORATORY AND EQUIPMENT	41,107-26	942-59	—	78-46	41,971-39	Less: Contingencies written off 106-23 1,177,414-60
" EXPERIMENTAL MACHINERY	25,691-39	4,013-99	—	—	29,705-38	" FUNDS OVERSPENT TO 31-12-38 119,612-64
" MACHINERY ESTATE	127,844-10	1,225-27	—	—	129,069-37	" DO 31-12-39 20,743-12 140,355-76
" MOTOR CAR	4,500-00	4,025-00	—	4,500-00	4,025-00	
" MOTOR ROAD ROLLER	7,386-03	—	—	—	7,386-03	
	Rs. 2,007,481-48	41,913-08	106-23	9,266-23	2,040,022-10	Rs. 2,040,022-10

March 18, 1940.
St. Coombs.ROLAND V. NORRIS,
Director.

THE TEA RESEARCH INSTITUTE OF CEYLON.

Dr.	LOAN ACCOUNT		Cr.	
	Rs.	Cts.	Rs.	Cts.
To GOVERNMENT OF CEYLON	Rs. 1,000,000-00			
	BY REPAYMENTS PRINCIPAL:--			
	1st Instalment 1929			18,227-00
	2nd do 1930			19,320-72
	3rd do 1931			20,479-00
	4th do 1932			21,708-60
	5th do 1933			23,011-09
	6th do 1934			24,391-74
	7th do 1935			25,855-23
	8th do 1936			28,730-36
	9th do 1937			30,310-53
	10th do 1938			31,977-61
	11th do 1939			33,736-38
	.. Balance ..			277,748-26
				722,251-74
	Rs. 1,000,000-00			Rs. 1,000,000-00

March 18, 1940
St. Coombs.

ROLAND V. NORRIS,
Director.

THE TEA RESEARCH INSTITUTE OF CEYLON.

BULLETIN No. 21.

11

REVENUE ACCOUNT AS AT 31st DECEMBER, 1939.—(Contd.)

	Rs.	Cts.	Rs.	Cts.	Rs.	Cts.
To PERSONAL EMOLUMENTS OF SCIENTIFIC STAFF:—						
Director	...	22,500-00	Brought forward	12,714-60		
Mycologist	...	20,775-00				
Agricultural Chemist	...	18,525-00				
Entomologist	...	17,254-10				
Plant Physiologist	...	13,307-31				
Biochemist	...	11,602-35		103,963-76		
" EMOLUMENTS OF JUNIOR AND SUB-SCIENTIFIC STAFF:—						
Junior Scientific Staff	...	36,065-05				
Subordinate Scientific Staff	...	4,349-23		40,414-28		
" LABORATORY:—						
Equipment and General Working Expenses	...	5,756-81				
Special Provision for Joint Research on Chemistry of Tea	...	5,039-49				
Furniture and Office Equipment	...	15-20		10,811-50		
" LIBRARY AND PUBLICATIONS						
Library	...	1,748-59				
Publications	...	Cr. 3,124-76		Cr. 1376-17		
			Carried forward	Rs. 166,527-97		
					Carried forward	Rs. 359,594-91

THE TEA RESEARCH INSTITUTE OF CEYLON.

REVENUE ACCOUNT AS AT 31st DECEMBER, 1939—(Contd.)

	Rs. Cts.	Rs. Cts.	Rs. Cts.
To SMALL-HOLDINGS:—			
Salaries and House Allowances	6,812.73		
Travelling and General Expenditure	3,253.18		
Brought forward		166,527.97	
FIELD AND FACTORY EXPERIMENTS:—			
Agricultural Chemist	4,042.73		
Plant Physiologist	3,736.82		
Miscellaneous Field Experiments	84.69		
Factory Experiments	1,771.57		
Food Production	104.65		
			9,740.46
TRAVELLING OF STAFF:—			
Officers' Expenses	2,226.46		
Insurance of Car	201.26		
Entertainment Allowance	108.50		
Drivers' Wages	1,333.50		
Drivers' Batta	297.50		
Running Expenses	3,497.80		
			7,665.02
MAINTENANCE OF BUILDINGS:—			
Laboratory	903.91		
Senior Staff Bungalows	1,341.76		
Junior Staff Bungalows	1,126.95		
Clerks' Bungalows	530.71		
Miscellaneous Lines and Buildings	288.51		
Passara Buildings	162.70		
Guest House	231.02		
			4,585.56
Brought forward			
Carried forward			Rs. 359,594.91

Carried forward Rs. 198,584.92

Carried forward Rs. 359,594.91

THE TEA RESEARCH INSTITUTE OF CEYLON.

BULLETIN No. 21

13

REVENUE ACCOUNT AS AT 31st DECEMBER, 1939—(Contd.)

Rs. Cts.
359,594·91

Rs. Cts.
198,584·92

Brought forward

To GENERAL SERVICES:—

Electric Power	4,140·00
Mechanic	737·85
Telephone Rent and Maintenance	563·50
Roads	440·67
Sanitation	1,053·17
Water Supply	809·07
Tappal Lorry and Book Fees	199·50
Nettikans and Drains	166·91
Upkeep of Grounds	889·37
Guest House	705·86
	9,705·90

MISCELLANEOUS:—

Incidentals	244·64
Ceylon Planters' Provident Society	10,551·75
Provident Fund, Junior Scientific Staff	4,135·44
Provident Fund, Subordinate Staff	1,327·22
Passages	3,750·00
Ceylon Nursing Assn. and	
Fraser Nursing Home	180·00
Medical Fees, Subordinate Staff	150·45
Medical Scheme, Junior Staff	1,263·00
Insurances	2,441·54
Watchmen and Caretakers	567·15
Conference Expenses	626·91
Rentals	591·86
	25,829·96

GOVERNMENT OF CEYLON LOAN

41,115·40

DEPRECIATION

38,718·62

BALANCE

45,640·11

Brought forward Rs. 359,594·91

ROLAND V. NORRIS
Director

Rs. 359,594·91

March 18, 1940.
St. Coombs.

REPORT

ON

ST. COOMBS ESTATE

FOR 1939.

Superintendent.—Mr. J. A. Rogers.

Mr. Rogers went on leave from April to December, 1939, during which time Mr. N. B. Parker acted in charge of the Estate.

ACREAGE.

			A.	R.	P.
Tea in Bearing	...	...	264	1	06
Tea — New Clearing 1937	...	...	20	0	00
Tea — New Clearing 1938	...	...	16	0	00
Nurseries	...	...	1	1	08
Fuel Clearings	...	...	27	0	00
Reserve available for planting	...	...	27	1	09
Building Sites	...	...	26	2	22
Waste Land, Swamps, etc.	...	...	32	1	14
Total Acreage	...	...	414	3	19

Weather.—Rainfall registered in 1939 — 96.08 inches on 207 days.

Rainfall registered in 1938 — 97.18 inches on 220 days.

Climatic conditions were most unsatisfactory during the first three months of 1939 as a result of drought and frost.

Crop.—Total crop harvested in 1939—151,929 lbs.—Estimated 185,000 lbs.

Total crop harvested in 1938—173,721 lbs.—Estimated 185,000 lbs.

Yield per acre—1939—575 lbs. on 264 acres.

Yield per acre—1938—657 lbs. on 264 acres.

The shortage of crop in 1939 was disappointing, and was chiefly due to the unfavourable weather conditions early in the year.

PRICES.

The average for High Grown Teas sold on the Colombo Market in 1939 was 84 cents, compared with 79 cents in 1938.

St. Coombs.—Gross average in 1939 — 84.74 cents per lb.

Gross average in 1938 — 80.29 cents per lb.

Nett average in 1939 — 79.74 cents per lb.

Nett average in 1938 — 75.16 cents per lb.

Profit on Estate Working Account.

1939 — Rs. 36,399.00, which is equivalent to Rs. 138.00 per acre on 264 acres

1938 — Rs. 41,152/00, which is equivalent to Rs. 156/00 per acre on 264 acres

Cost of Production.

1939 — 55.69 cents per lb. — Estimate 51.48 cents per lb.

1938 — 52.39 cents per lb. — Estimate 52.64 cents per lb.

Capital Expenditure.

1939 — Rs. 13,595/00 = 8.95 cents per lb. — Estimate 9.64 cents per lb.

1938 — Rs. 20,301/00 = 12.15 cents per lb. — Estimate 13.22 cents per lb.

Cultivation—works were carried out according to programme. Artificial manure mixtures have had to be altered from time to time since September according to supplies available owing to war, but the policy of supplying the same quantities of plant food has been approved.

Pruning cycles are being extended to 4 years.

Green Manures.—*Crotalaria usaramoensis*, and *C. anagyroides* have been planted this year; the former proved a failure due to immature seed, and the latter has not been satisfactory.

Tephrosia vogelii has not been used owing to eelworm attack.

Diseases.—Tea Tortrix has made no serious appearance.

Further Poria patches have been treated.

Phloem necrosis shows no marked increase on this estate.

Tea Nurseries.—The plants in the reconditioned nurseries do not show as vigorous growth as one would wish, probably due to drought in the early stages of growth.

Water has been laid on with piping and taps, and the subject of watering nurseries has been carefully studied by Dr. Eden.

1937 New Clearings (20 Acres).—These clearings have made good growth, and vacancies have been supplied. The well-grown plants of $\frac{3}{4}$ -inch thickness were centred late in the year.

1938 New Clearings (16 Acres).—On modified contour system. The severe drought early in the year resulted in a very large number of casualties in the “seed-at-stake” areas. These were again supplied with “seed-at-stake,” and similar results must be expected if serious dry weather is experienced early in 1940.

It is evident that “seed-at-stake” has proved most disappointing in this clearing.

The following anti-erosion measures have been undertaken in these clearings with success:—

Planting of tea seedling hedges above all roads, using self-sown seedlings from old tea areas.

Road drains and ravines have been bunded with sods of *Paspalum* grass.

This grass has also been planted on the edges of banks above roads.

Crotalaria usaramoensis seed was planted twice and failed, and *Crotalaria anagyroides* was planted at the end of the year.

Labour.—At the end of 1939 there were 395 working labourers on the estate, which is equivalent to 1.40 labourers per acre in bearing, which is ample for all present requirements.

Labour used on 1937 and 1938 Clearings during 1939 amounted to 4,686 labourers.

In addition, 11,292 labourers were lent to the Tea Research Institute during the year under review.

Manufacture, Etc.—No. 1 and 2 Rollers have been fitted with stainless steel jackets, and with kitul-wood tables and battens.

The C.C.C. horizontal rotary roll breaker is giving great satisfaction.

Glazed windows in the rolling room have replaced the former venetian windows, which is a great improvement.

Manufacture is on systematic and sound lines, and takes place under hygienic conditions.

General.—Improvement in the general appearance, and in the spread and vigour of the tea is a pleasing feature, also the good growth of new wood in fields pruned, and, given favourable conditions, the tea appears to be capable of satisfactory yields.

HUBERT TONKS,

Visiting Agent.

METEOROLOGICAL OBSERVATIONS, 1939.

ST. COOMBS.

Month	Temperature				Mean Relative Humi- dity	Rainfall Inches	No. of Rainy Days	Sunshine hrs. mts.
	Mean Max.	Mean. Min.	Adopted Mean	Mean on Grass				
January	74.3	55.5	64.9	48.9	70	3.65	10	210 39
February	76.3	52.5	64.4	43.0	58	0.26	4	255 46
March	79.9	53.8	66.8	45.6	60	1.53	7	276 15
April	76.6	59.3	68.0	55.1	80	11.78	26	152 46
May	76.6	59.9	68.3	56.1	79	7.29	13	210 54
June	71.6	60.4	66.0	58.9	82	13.63	26	82 14
July	69.2	59.4	64.3	57.8	85	13.60	24	122 36
August	70.1	59.1	64.6	56.9	83	11.62	20	158 01
September	72.7	58.3	65.5	55.4	80	9.06	19	154 26
October	72.9	58.7	65.8	55.4	83	10.08	25	124 03
November	72.1	58.7	65.4	54.6	77	9.50	17	127 04
December	74.0	55.6	64.8	49.1	74	4.08	16	203 09
Annual	73.9	57.6	65.7	53.1	76	96.08	207	2,077 53
	Means					Totals		

REPORT

OF

THE DIRECTOR,

TEA RESEARCH INSTITUTE OF CEYLON

FOR 1939.

Administration.—The administrative arrangements in force in the previous year were continued without change.

Finance.—Restriction, which for the first three months of the year was at the rate of $7\frac{1}{2}$ per cent, was increased to 10 per cent as from the 1st April, 1939, but this figure was again reduced to 5 per cent after the outbreak of war. The second change was, however, made too late in the year materially to effect exports. The latter totalled 228,062,617 lbs. on which the research cess, which remained at 14 cents per 100 lbs., yielded Rs. 318,871 against Rs. 334,705 received in the previous year.

The receipts from St. Coombs Estate at Rs. 36,399 were also lower, the severe drought in the first quarter and unfavourable weather in July adversely affecting the crop.

With miscellaneous receipts at Rs. 4,325, the total revenue for the year amounted to Rs. 359,595, the figure for 1938 being Rs. 379,856.

Expenditure on laboratory revenue account, excluding depreciation and interest charges on the Government Loan, amounted to Rs. 234,121, against an estimate of Rs. 233,200. After making provision for depreciation of Rs. 38,719, and meeting interest charges on the loan amounting to Rs. 41,115, the surplus on general revenue account for the year was Rs. 45,640.

Capital expenditure was incurred amounting to Rs. 66,383 distributed as follows: Repayment of Government Loan Rs. 33,736; Lines and Buildings Rs. 9,885; Land Development Rs. 13,805; and Machinery and Equipment Rs. 8,957. Liquid assets as at 31st December, 1939, after allowing for

liabilities to creditors, accrued interest on the Loan and the Furlough and Passages Reserve, amounted to Rs. 229,030. The liability under the Depreciation Reserve at the same date amounted to Rs. 358,115, so that the latter was represented in cash to the extent of 60.2 per cent.

An application has been made for a grant from the Colonial Development Fund to defray the cost of the appointment of an additional research officer for work on Phloem necrosis.

St. Coombs Estate.—The rainfall for the year, 96.08 inches, falling on 207 days, was only slightly lower than that in 1938 but distribution was most unfavourable. A severe drought occurred in the first three months of the year, with frost in February, and crop in this period was in consequence the lowest on record. After rains in April, May produced a crop of 122 lbs. per acre, making up part of the deficit. Exceptionally windy and severe weather in July again checked flushing, however, and the final crop at 151,929 pounds was 33,000 pounds below the estimate.

The unfavourable weather was also most detrimental to the success of the 1938 clearing, particularly in those areas planted with seed-at-stake which appears to be quite unsuitable for the patana soils of the estate under the conditions which have prevailed in the past two years.

The loss of crop in the first quarter of the year, when prices on the Colombo market are normally at their maximum, was reflected in the receipts for tea sales. This was however offset to some extent by the favourable prices obtaining after the outbreak of war.

38,553 pounds of tea were sold to Government under the short term contract. Details of these and other sales are given below:—

		Gross Price		Nett Price
		lbs.	Cents	Cents
Colombo sales	...	100,684	83.57	79.35
Sold to Tea Commissioner, Colombo		33,285	82.41	77.99
Sold in London to Minister for Food		5,268	91.50	78.11
Experimental teas, sold in London		11,547	98.60	89.05

The average gross price realised for all teas sold was 84.74 cents against 80.29 cents in 1938. The average nett price was 79.74 cents, cost of production being 55.69, the increase in the latter figure over the estimate of 51.48 cents being of course due to the shortage in crop.

Of the estimated crop for 1940, 70 per cent has been accepted by the Minister for Food at an average price of 83.55 cents per pound. This should leave about 55,500 pounds available for the local market.

During the year a C.C.C. horizontal rotary sifter fitted with stainless steel meshes and aluminium delivery shoots, was added to the factory equipment and has given excellent results. The brass tables and boxes in the old rollers were replaced by kitul wood tables and stainless steel boxes.

Food Production.—After the outbreak of war trial plots of various foodstuffs were planted up to ascertain what varieties, if any, might be suitable for large-scale production on up-country estates. The results were not very encouraging, bulrush millet alone of the various cereals tried proving successful. A larger area will be planted up under sweet potato and Rangoon beans when weather conditions permit. Further details of these trials will be found in the Report of the Agricultural Chemist.

Labour.—It is satisfactory to record that, up to date, St. Coombs has been free from the labour troubles which have disturbed so many estates in the district.

Staff.—Mr. Rogers, the Superintendent, was on home leave from April to December and Mr. Lamb, Biochemist, returned from leave on 1st July. Dr. Tubbs, the Plant Physiologist, proceeded on leave in March and on the outbreak of war received a commission in the 2nd Battalion, the Durham Light Infantry, and is now on active service.

Mr. King, Mr. Lamb and Mr. Parker (Acting Superintendent) were also mobilised with the Ceylon Defence Force and were absent from duty till the end of September.

An addition to the Senior Staff was made by the appointment in December for a period of three years of Dr. T. E. T. Bond as Assistant Mycologist. Dr. Bond will be chiefly concerned with investigations on Phloem necrosis.

Conference.—The Sixth Conference of the Institute was held on the 13th and 14th February, 1939, and was very well attended, nearly three hundred persons being present at the first day's proceedings held at the Radella Club. On the second day one hundred and fifty visitors came to St. Coombs where special demonstrations had been arranged in each Department.

A satisfactory feature of the Conference was the greater readiness, as compared with previous occasions, of visitors to join in the discussions which were of much interest.

We were exceedingly fortunate in having with us Sir E. John Russell F.R.S., Director of the Rothamsted Laboratory, who opened the discussion on Soil Management and took an active part in the proceedings. Sir John

particularly stressed the importance of continuity in the Institute's major field experiments, especially those concerned with manuring and cultivation. The Institute has always urged that such a policy should be maintained as it is only by such means that a final judgment can be reached on matters concerning which there may at present quite reasonably be differences of opinion.

A full report of the proceedings of the Conference was published in Parts I and II of *The Tea Quarterly*.

Co-operation with other Research Stations.—Owing to the outbreak of war the visit of the Chairman and Director to Tocklai and the Assam tea district had to be abandoned. Mr. Harrison, one of the Chemists at Tocklai, however, visited St. Coombs. The scheme for joint research on the chemistry of tea was brought a stage further in July by the appointment of Dr. A. E. Bradfield as Research Chemist. Dr. Bradfield after obtaining preliminary experience in Brokers' offices has since been working in the laboratory of Messrs. J. Lyons & Co.

Advisory Work.—In spite of the conditions prevailing in the last quarter of the year, the number of enquiries received showed little or no fall from the previous year. Absence of Senior Officers on leave or military duty, however, reduced the number of visits paid to estates from 180 to 150. On the other hand, the number of visitors to St. Coombs, 220, was an increase on 1939. Two days a month, the second and last Wednesdays, are now designated as Visitors' Days though a great many visitors come on other days by appointment. For the convenience of visitors a small but comfortable guest house was opened in February. This contains sleeping accommodation for five persons.

As usual lectures were given at many meetings of District Planters' Associations. The Director also attended the meetings of the General Committee of the Planters' Association of Ceylon, the Central Board of Agriculture, and occasional meetings of the Ceylon Estates Proprietary Association.

On the initiative of the Institute, arrangements were also made for periodical meetings between representatives of the three Research Institutes and the Colombo fertiliser firms. At these meetings the position in regard to available stocks of manure under war conditions has been reviewed and it was possible to arrive at arrangements fair to all concerned for the best utilisation of such stocks.

Publications.—These comprise the four issues of *The Tea Quarterly* and Bulletin No. 19 (Annual Report for 1938). A combined index for all the Institute's publications to the end of 1938 was also prepared and sent to Press at the end of the year. There was a further increase in the number of subscribers and the income from this source and from advertisements was sufficient to leave a profit of Rs. 3,125, after meeting the cost of printing and distributing all publications.

TECHNICAL

Diseases and Pests.—There was a striking increase in the number of enquiries received by the Mycological Department which were nearly twice as many as in the previous year. This was not, however, due to any particular increase of the usual diseases but rather to attention becoming focussed on the incidence up-country of Phloem necrosis and the discovery on a few estates of serious damage in mature tea caused by an eelworm, *Anguillulina pratensis*, the latter being quite distinct from the already known eelworm, *Heterodera marioni*, which attacks tea seedlings and many green manure plants.

The subject of Phloem necrosis was fully discussed at the Conference held in February when a full description was given of the general symptoms of the disease and planters were asked immediately to report any suspicion of its occurrence on their estates. Shortly afterwards illustrations of attacked bushes were issued to all estates desiring these to assist in identification. These measures met with an immediate response and large numbers of specimens were received for examination. These, unfortunately, confirmed the Institute's suspicion that the disease was much more widely distributed than had at first been realised and it is in fact probable that it occurs in practically all areas at elevations over 4,000 feet. At lower elevations very few cases have been positively identified and it would appear that climatic conditions must have a controlling influence, though the way in which these operate is as yet unknown. The fact, however, that the disease is caused by a virus makes it likely that the agent of spread is an insect vector and the incidence of this vector might well be profoundly modified by climatic factors. The spread and development of the disease would appear to be relatively slow. While this is to the good in so far as it means that areas attacked will not rapidly become unproductive, the prolonged lag between infection and the time when visible symptoms occur greatly complicates the devising of remedial measures and delays experiments on transmission. It has been suggested that old age, or possibly a deficiency in certain minor elements of the soil, may have an influence on the incidence of this disease. There is little evidence however to support either of these contentions. The disease has been transmitted *artificially* to seedlings though the susceptibility of young plants to *natural* infection in the field is at present uncertain and is being closely investigated. As regards minor elements, infected bushes transplanted in soil carrying a normal healthy crop have shown no tendency to throw off the disease.

As already mentioned, an additional research officer has been appointed to the Mycological Division for work on this disease which is receiving the fullest attention in all its aspects.

Readers are referred to the report of the Mycologist and to articles in *The Tea Quarterly*, 1939, Vol. XII, pp. 75-86 and 110-130, for fuller details of this disease and of the measures which, it is suggested, should be taken

in regard to it. Of these the removal of unproductive bushes is the first step

Details in regard to the eelworm *Anguillulina pratensis* will be found in the report of the Mycologist, and in *The Tea Quarterly*, Vol. XII, pp. 131-139. Though this has been identified so far only on a few estates, the position is disquietening as the damage and loss of crop is very severe and further investigation has shown that on these estates the eelworm is very widely distributed. It is true that the rate of multiplication is probably slow, markedly slower than that of the root knot eelworm *Heterodera marioni*, but, once the soil becomes infected, no practical measures are at present available by which this can be freed from the pest. One is limited therefore to attempts to prevent its spread to areas at present uninfected. It will be appreciated that this is an exceedingly difficult problem in view of the ease with which infected soil may be transported, *e.g.*, by erosion or on the feet of labourers, to other fields.

Anguillulina pratensis has a wide range of other host plants, including many of the common green manures, *Tephrosia vogelli*, for example, being as susceptible as tea. In this connection, however, it may be worth while noting that *Desmodium gyroides* appears to be resistant to attack.

Passing to insect pests, it is satisfactory to record the success obtained in the control of Tortrix by means of the larval parasite *Macrocentrus homonae*. The latter now appears to be widely distributed and though it is not claimed that in this way Tortrix will be eliminated, there is every reason to think that such attacks as occur will be reduced to a level which will cause little damage. In these circumstances the Institute felt justified in recommending the suspension of the regulations made under the Plant Pest Ordinance in regard to Tortrix control. This recommendation was accepted and the regulations suspended by notification in the *Government Gazette* of the 12th May, 1939. While, therefore, Tortrix remains a declared pest, it is no longer compulsory to collect and destroy Tortrix egg-masses, larvae and pupae or to forward data regarding such collection to the Department of Agriculture.

In cases where Tortrix attacks of any intensity may occur Superintendents are asked to send in to the Institute specimens of the caterpillars in order that these may be examined for the presence of the parasite. Should this not occur supplies of the parasite will be sent for liberation.

In regard to Shot-hole borer, *Xyleborus fornicatus*, there is, unfortunately, not the same success to record. There is a considerable difference of opinion at present in regard to the status of this pest and few reliable data as to the actual loss of crop which results from its presence. In the Uva Province, and in some of the drier areas, there is undoubtedly much genuine alarm regarding shot-hole borer and this has no doubt been accentuated by the damage due to breaking of infested branches becoming more visible in periods of drought such as have been experienced in the

past year. In the low-country, on the other hand, the pest is less feared and, *under present standards of cultivation*, loss of crop does not appear to be of economic importance. It is only fair, however, to remember that in these areas the average age of the tea is younger and liberal cultivation has been applied in most cases since the tea was planted.

Besides, direct loss of crop, the opinion has been expressed that extensive wood rot, originating in the borer galleries, is set up as a result of borer attack, the discoloration often noticed in the galleries being regarded as the first stage of rot. Investigations so far carried out by the Institute lend no support to this belief, none of the fungi isolated in repeated examinations of the galleries having been found capable of setting up wood rot. On the other hand it must be admitted that if breakage of branches is frequent areas are continually being exposed which are liable to invasion by wood-rotting fungi. This fact, and the dieback which may occur as a result of the beetle boring through the young buds, are probably responsible for most of the damage caused directly or indirectly by shot-hole borer.

It is generally agreed that liberal cultivation does much to reduce the direct loss of crop in so much as the healing of galleries is accelerated and loss of branches reduced. Such treatment seems, however, to do little to reduce the incidence of attack. In such circumstances some method of biological control, if it could be found, appears to offer the only radical solution. Unfortunately, the prospects of success in this direction seem somewhat remote. In the first place, unlike most other pests, the beetle spends practically its whole life *inside* the wood of the bush and is therefore much less liable to attack by parasites or predators. Xyleborus contains a very large number of species, very few of which are known to become parasitised. Enquiries made in the United Kingdom, India, Java and America have so far failed to provide any material which shows the least promise. Such enquiries must of course continue, but it is necessary to say quite plainly that it seems probable that it will be only by some exceedingly lucky chance that any natural controlling agent will be found.

Plant Physiology.—As already mentioned, Dr. Tubbs, the Plant Physiologist, proceeded on leave in March and since the outbreak of war has been on active service in France. In these circumstances the work of the section had to be reorganised under the control of the Mycologist and the Agricultural Chemist, the latter being responsible for the field work. While some of the less important lines of work have had to be suspended it has been possible to arrange for all major investigations to be continued. Of these, tea selection and the vegetative propagation of selected bushes are outstanding problems. A general account of the organisation of this work was given at the Conference in February and readers are referred to *The Tea Quarterly*, Vol. XII, pp. 38-51. Further experience has made it possible to make some modifications in the procedure first adopted in

regard to selection for yield. It is obviously desirable that as large a number of desirable bushes as possible should be tested for yield and other qualities. It is equally obvious that of these a very large proportion will sooner or later have to be discarded and, in order to avoid waste of effort, it must be advantageous to make such discards as early as possible, due precautions being taken that any potentially valuable material is not lost owing to records being too hastily discontinued. A careful examination of the earlier records showed, however, that it would be possible to adopt the following procedure: After each of the first two groups of eight pluckings 50 per cent are eliminated, the discards being reduced to 33 per cent after each of the subsequent eight pluckings until forty pluckings have been made in all when the final selection is made from the survivors. A very large saving in labour is effected by this more stringent selection and there is no reason to think that bushes of real value have been eliminated. The final result will be the retention of some 2 per cent of the original bushes for propagation and clonal trial.

At the same time quality tests, referred to later in this report, have been carried out and this may lead to a further small elimination of bushes from those first approved.

In regard to propagation, a good deal still remains to be done in improving the technique, particularly in the later stages, *i.e.*, in the interval between striking and planting out. Losses in this stage are still much too high even under favourable weather conditions. These aspects of the question are being closely studied and in course of time there should be a very considerable number of tea clones under observation. At this stage the question of immunity or partial resistance to diseases and pests will naturally have to receive attention.

Agricultural Chemistry.—The original manurial experiments laid down by the Institute have now been under observation for nine years and have been considerably widened in scope since their initiation. Information of the highest value has been obtained from this work which has been passed on to estates in our advisory work with much agricultural and economic benefit to the Industry. The importance of such information, based as it is on precise experimental evidence, has been enhanced in the conditions arising from the war leading naturally to a considerable dislocation of normal manurial supplies. The Institute had several months before the war prepared a memorandum on this subject indicating in what directions difficulties were to be anticipated and suggesting the setting up of a consultative committee to deal with the situation. Subsequently to the outbreak of the war this suggestion was adopted in a slightly modified form and, as has already been mentioned, meetings have been held, and will continue to be held as required, at which the fertiliser position has been reviewed and suggestions made as to the best and most economical utilisation of available stocks.

In order that prices may be to some extent stabilised this has necessitated a voluntary rationing scheme in regard to ammonium sulphate, the fertiliser most seriously affected by war conditions. At the beginning of the war the export of nitrogen from the United Kingdom was at first banned. This ban was soon lifted to the extent that nitrogenous manures could be exported under permit. But from this cause, and freight difficulties, supplies have naturally been restricted and irregular though it is gratifying to note that imports have been considerably more than might reasonably have been expected. The situation, however, is most unstable and may deteriorate at any time; it is therefore obvious that a conservative attitude must be maintained in regard to the utilisation of existing stocks. The Institute is closely in touch with the position and will be glad at any time to advise estates in regard to their manurial policy.

As a corollary to the above considerations, it follows that whatever manurial supplies may be available must be used in the most effective and economical way. Attention, therefore, is called to the section in the Report of the Agricultural Chemist dealing with the vexed question of pruning mixtures in which further evidence is brought forward in regard to the advantages of delaying the application.

Some doubts were recently expressed in regard to possible losses of nitrogen from fertiliser mixtures on storage, particularly those containing certain forms of mineral phosphate and ammonium salts. The question has been thoroughly investigated by the Institute in collaboration with the Coconut Research Scheme and it is satisfactory to find that there is nothing to be feared from the storage of mixtures of the type commonly in use in tea.

An investigation on the effects of cultivation and weeding has been in progress for the past three years, the experiment having just completed its first pruning cycle. The results were discussed in some detail at the last Conference, *vide The Tea Quarterly*, Vol. XII, pp. 24-37, and further particulars will be found in Dr. Eden's report. It is only necessary, therefore, to say here that intensive cultivation resulted in a diminution in crop of some five per cent, very possibly due to a restriction in the actual amounts of roots produced under these conditions. The evidence at the moment suggests that annual forking over the whole area may be the normal standard to adopt in order to obtain the best results from the manures supplied or to preserve a mulch of leaf and ground cover to conserve the soil. Presence of weeds, in the selectively weeding plots, also depressed yield to some extent, though these plots gave as good a response to manure as the clean-weeded plots. It does not, however, necessarily follow from this that selective weeding is to be condemned. It has still to be seen whether this loss of crop persists; it may well prove to be a temporary phase and in course of time, due to better conservation of soil, the plots with a weed cover may not improbably

maintain a higher fertility level than those which are clean-weeded. It is a matter on which a long view must be taken.

Manufacture and Biochemistry.—Mr. Lamb, Biochemist, was on home leave till the 1st July and again away during September on mobilisation. During these periods the Director was in charge of the Department. Further work on a commercial scale was continued with the Clivemeare roller. In the last Annual Report, and in *The Tea Quarterly*, Vol. XII, pp. 147-150, details will be found of the results obtained. It will be remembered that initial work with this roller quickly showed the advantages to be obtained by its use in regard to even infusions and good liquors. The main disadvantage was the appearance of the made tea which at first was such as to be unacceptable either in Colombo or London. Prolonged experimental work was therefore undertaken to modify the process in such a way as to remedy as far as possible the defects in appearance while retaining the other desirable results. These experiments were very largely successful, and the first commercial invoices sent to London in 1938 were very well received, the Clivemeare invoice obtaining a premium of one penny per pound over normal manufacture. These particular invoices had been manufactured during the South-West monsoon, *i.e.*, at a period when liquors were naturally of chief importance. It was therefore obviously desirable to extend the comparison to teas made in the flavoury period when quality would probably be the determining factor. Two further experimental invoices were therefore manufactured on alternate days in February-March, 1939, one by the Clivemeare process and the other under normal conditions of manufacture. The London reports indicated that the appearance of the Clivemeare tea had been markedly improved since the experiments first began and was now such as to be quite acceptable in the London market. Opinion was also unanimous in regard to the good colour and evenness of the Clivemeare infusion, particularly of the Fannings, and the colour and strength of the liquors. The sale prices obtained confirmed these reports, the Clivemeare tea averaging 2.7 pence per pound more than the normal manufactured tea.

At the same time doubts were expressed by certain tasters as to whether the Clivemeare teas fully retained the normal Ceylon characteristics, and some apprehension was shown as to the position which might arise if this process were generally adopted, one report expressing the view that in this case "the whole basis and type of Ceylon offerings would almost certainly be radically altered." There was general agreement as to the merits of the Clivemeare teas as such; the question was obviously as to what amount of this type could be absorbed on the market to satisfy blenders' requirements without at the same time losing the premium the market at present seemed willing to pay.

In these circumstances it seemed necessary that further commercial invoices of Clivemeare tea should be sent for sale in London in order

that more information on these points might be obtained. Unfortunately, at this stage the war intervened and, having regard to the conditions laid down in the Government contracts for tea to be supplied to the Minister for Food, and the attitude of the Colombo market towards Clivemeare teas, the conclusion was reluctantly reached that no useful purpose would be served by continuing the experiment until more normal conditions were again reached. Commercial manufacture under the Clivemeare process was therefore suspended.

Apart from the Clivemeare process, experiments have been in progress with normal rollers in regard to batten types and charging intervals. With battens systematic comparisons are being made starting with plain tables and proceeding to tables fitted with different types of battens of the cutting or twisting type.

Interesting experiments are also in progress in connection with firing, the comparison here being between different firing temperatures. Details of these will be found in the report of the Biochemist. On what must be regarded at the moment as the more theoretical side, work is proceeding on the chemistry of tea leaf and the mechanism of the fermentation system. In both these subjects considerable progress has been made but the details are highly technical and cannot at present be conveniently summarised in non-technical terms. The work on the chemistry of tea is of course intended to link up with similar work which has now been commenced in London under a scheme jointly financed by Ceylon, India and the Netherlands East Indies. Dr. A. E. Bradfield who was selected as research chemist under this scheme took up his duties in the middle of the year and, after gaining preliminary experience in regard to tea in various brokers' offices, has been working in the laboratory of Messrs. J. Lyons & Co., Ltd., London. Close contact is also being maintained with the Tocklai laboratory where similar work is proceeding. It is hoped Mr. Lamb may be able to visit Tocklai during 1940 in order that the lines of investigation and the results so far obtained may be fully discussed and co-ordinated.

Since the outbreak of war the Institute has been closely watching the position in regard to packing materials. It soon became clear that the question of aluminium linings might become acute in view of the importance of this material for military purposes and the control of aluminium stocks by the British Government. It seemed therefore desirable from every point of view that the use of alternative lining materials should again be considered. As has already been made clear in the Institute's publications, extensive trials have already been carried out with such materials as Kraft Paper, Cellophane and Pliofilm. In regard to Kraft Paper, particularly, the Institute was satisfied that this material was in every way suitable as a lining. It is true that the paper is coated with a very thin layer of aluminium. Its use, however,

would result in a very much reduced demand for aluminium for the tea industry and the indications were that supplies of Kraft paper could be obtained from Empire sources at a price appreciably below the present cost of the normal metallic foils, in regard to which, particularly with aluminium, the future position is very obscure. Admittedly, materials of this kind are not popular with buyers owing to their relatively low second-hand value. It was felt, however, that considerations of this kind could not well be maintained under war conditions and that it would be desirable to approach the Minister for Food in order that the terms of the Government tea contract might be adjusted so that the use of alternative lining materials might be made permissible. Action on these lines was eventually taken but it is regrettable to have to report that it seems unlikely such permission will be granted in the immediate future.

With regard to tea chests also the question of future supplies requires close consideration. Much has already been done to replace the deficit in imported chests by locally made chests. At the moment these have been chiefly made from Albizzia though several other local timbers have also been tried. Many excellent locally-made chests are now available but a strong warning must be issued stressing the imperative necessity for the most stringent inspection of such material in order to eliminate any wood which may offer evidence of attack by boring beetles. Chests attacked in this way may be rejected by the quarantine authorities of certain countries with considerable inconvenience and loss to shippers. Provided thorough inspection of such chests is carried out in suppliers' stores, there should be little difficulty in avoiding hazards of this kind, and there is a favourable opportunity for the development of a local industry which has hitherto failed to grow largely from the neglect of such precautions.

Finally, in regard to the work of the Biochemical Department reference must be made to the important contribution which is being made to the Institute's work on tea selection by the improvisation of methods for the manufacture and testing of leaf from individual selected bushes. It is clear that so far as Ceylon is concerned quality is of equal, or more, importance to yield. Any method of tea selection must therefore take this factor into account and it is satisfactory to record that the methods which have been devised for dealing with this aspect of the work are giving consistent results of the greatest interest.

Small-Holdings.—The Institute has continued to maintain two advisory officers for small-holders, in the Gampola and Baddegama areas respectively. There is no question that useful results are being obtained from such work. Interest is maintained by frequent inspection of holdings and the organisation of competitions amongst small-holders in which prizes are offered for the best worked holdings. On large numbers of these improvements are now visible in the form of modern drainage systems and terracing, planting of shade and green manures and a higher standard of pruning and plucking.

Acknowledgments.—It is a pleasure to acknowledge the assistance and co-operation which the Institute has continued to receive from the Planters' Association of Ceylon, the Ceylon Association in London and the Ceylon Estates Proprietary Association.

Our thanks are due to the following gentlemen who kindly acted as a Selection Committee in London in regard to the appointment of a research officer for work on Phloem necrosis: Sir Frank Stockdale, K.C.M.G., C.B.E., Sir E. John Russell, O.B.E., D.Sc., F.R.S., Sir Edwin Butler, C.M.G., C.I.E., D.Sc., F.R.S., and Professor F. L. Engledow, C.M.G., F.R.S.

As in previous years our grateful acknowledgments are due to Messrs. George Steuart & Co., Messrs. James Finlay & Co., Ltd., the Anglo-American Tea Trading Co., the Nayabedde Estate Co., and the Scottish Tea & Lands Co. of Ceylon Ltd., for facilities granted in connection with field experiments, and to the Superintendents of Gonakelle, Wikiliya, and Sarnia Estates for their co-operation in such experiments. Numerous other Superintendents have also assisted us in various directions and for this and for kind hospitality extended to members of the Staff our grateful thanks are due.

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Mr. R. H. Horne until he proceeded on leave kindly acted as Convener of the tasting team in Colombo, while Mr. E. B. Loudon-Shand acted in a similar capacity in London. Mr. Horne also carried out innumerable additional tastings in his personal capacity. During his absence Mr. Kane and Mr. Pelly Fry kindly carried out his work. Special thanks are also due to the following gentlemen who at much inconvenience to themselves regularly assisted us by tasting experimental samples: Messrs. G. H. Yuille, M. P. Saunders, J. M. Westwood, H. W. T. Sherwood, C. E. Allan and D. F. Armitage.

Mr. F. J. Whitehead, as always, has placed his unique experience in regard to tea manufacture and engineering problems at our disposal, while Mr. H. Tonks, our Visiting Agent, has always been ready to accord valuable guidance and assistance on estate matters. To both these gentlemen our cordial thanks are extended.

The Reports of the Scientific Staff are appended.

ROLAND V. NORRIS,
Director.

REPORT

OF

THE MYCOLOGIST

FOR 1939.

Staff.—The Mycologist assumed part of the duties of the Plant Physiologist when the latter proceeded on leave on March 1st. He also had acting charge of the entomological division during September, while the Entomologist was on military service.

An increase in the subordinate staff of this division was made by the appointment of Mr. G. A. Palanathan as laboratory attendant. He took up his duties on May 26th.

Mr. H. T. P. Samarasekera worked in the mycological laboratories from August 25th to September 22nd, while undergoing post graduate training before taking up his duties on a local estate. Mr. Samarasekera is not a member of the Institute staff, but the Mycologist has assisted in the direction and supervision of the scientific investigations carried out by him on the estate.

Advisory.—There has been an abnormal increase in the advisory work of this division during the year; 1,025 letters were received and 942 despatched. The corresponding figures for 1938 were 569 and 561, respectively. Consignments of diseased plants received for examination numbered 704 as compared with 369 for 1938, and 294 for 1937. The number of consignments gives but a rough measure of the number of specimens actually examined, as a consignment may consist of one tea bush or a dozen. In one instance, 45 branches, each from a different bush, were sent for diagnosis. Consignments on the average have been larger than usual, and the number of actual specimens examined must total several thousands this year.

The abnormal increase in advisory work and laboratory examinations has not been due to an abnormal increase in the amount of disease in the tea fields. It is largely due to attention having been directed to the presence of a particular disease up-country viz., Phloem necrosis, and to the discovery of a serious parasitic eelworm *Anguillulina pratensis*, in the soils of certain tea fields.

39 visits to estates were made for investigational and advisory purposes in the Agrapatna, Badulla, Dimbula, Dolosbage, Galaha, Hewaheta, Kotmale, Madulkelle, Maskeliya, Matale, Nuwara Eliya, Nivitigala, and Uda Pussellawa districts.

Addresses were given to the Dimbula, Dickoya and Nuwara Eliya District Planters' Associations and to the Ceylon Estates Proprietary Association during the year.

Publications.—In addition to the papers published in *The Tea Quarterly* the following article was also issued from this Division.

A Blight of Carrot Leaves. By C. A. Loos. "Tropical Agriculturist," Vol. XCIII, No. 6 pp. 343-354 (1939).

Phloem necrosis.—At the conference held in February, the co-operation of planters was requested in order that the distribution of the disease known as Phloem necrosis could be more accurately determined. That co-operation was immediately forthcoming and is gratefully acknowledged here.

The disease has now been definitely identified from 103 estates. Their distribution is such as to suggest that the disease occurs throughout the tea area above 4,000 feet. It has been recognised on very few estates below that elevation. No satisfactory explanation can yet be offered why the disease occurs mainly above the stated elevation.

A general account of the disease has been published in *The Tea Quarterly*, Vol. XII, pp. 75-86 and pp. 110-130, and reproductions of photographs illustrating the symptoms of the disease have been supplied to estates. Numerous demonstrations have also been given in the laboratories and in the field. In these ways the planting community has become acquainted with the field symptoms, and it is probable that many estate managers are aware of the presence of the disease on the estates under their charge but have not reported its occurrence to the Institute. In order to obtain exact information of its present distribution and to determine its spread (if any) later, estates would assist the Institute greatly by reporting the occurrence of the disease wherever found. First reports should be accompanied by specimens for verification. It is sufficient to send branches only, exhibiting the symptoms noted, but such specimens should arrive in as fresh a condition as possible.

Between November, 1936 and July, 1938, 25 bushes showing symptoms of necrosis were removed from various estates, and transplanted amongst healthy tea on St. Coombs. The stems were cut back and the roots washed free of adhering soil. Attempts were made to graft a root of each diseased plant to a root of a healthy plant *in situ*. In no case was a union formed. The great majority of the bushes survived the transplanting, and in all cases the bushes on recovery exhibited the same symptoms as were originally observed. The prolonged drought during the early months of 1939 caused the death of some of these bushes, but in October, 1939 when the bushes were removed, eleven still survived with symptoms of Phloem necrosis as marked, if not more so, as those observed before transplanting. The change of site, to soil bearing bushes showing no symptom of the disease, did not assist the diseased bushes to throw off the symptoms. None of the healthy bushes has yet shown any symptom of the disease.

Three of the bushes before transplanting exhibited symptoms of necrosis in parts of the bushes only. Despite transplanting, the disease apparently has not spread throughout those bushes. The symptoms could still be found in parts of the bushes only.

This experiment indicates that, although a change of soil and climate does nothing towards helping the bush to recover, the disease is not transmitted easily and the spread of the disease through a bush may be very slow.

In view of the evidence of a marked increase in the number of affected bushes in plots used for an experiment with Boron reported last year, (Bulletin No. 19 p. 29) other plots have been selected on St. Coombs and other estates to determine the rate of spread. It is hoped that in time such plots will afford valuable evidence on this point.

Anguillulina pratensis.—The most important pathological event of the year was the discovery of the eelworm, *A. pratensis*, as the cause of a serious disease of tea. A full account of it has been published in *The Tea Quarterly*, Vol. XII, pp. 131-139. This eelworm should not be confused with the better known one, *Heterodera marioni*, which causes swellings or root knots on the roots of tea seedlings, dadaps, Tephrosia and many other plants, and which was reported as a pest of adult tea in the last annual report.

Very few details of the life-history of *A. pratensis* are known, and its mode of life makes such data difficult to obtain. Attempts are being made to obtain this information, and so far, the investigations indicate that the rate of multiplication is very slow as compared with that of other better known eelworms such as *H. marioni*. This, however, is not altogether a matter for congratulation, because tea is a permanent crop and cannot be removed from the ground before the eelworm begins to make its presence felt.

Before the tea shows any above-ground symptoms that anything is amiss, the roots and the surrounding soil are heavily infected. The detrimental effect of this pest in some fields can be demonstrated, by means of yield examinations, as far back as 1929, and it may fairly be assumed that this eelworm has been in such soils for many years before that. It is now impossible to determine when, where or how infection of Ceylon tea soils occurred.

Unfortunately, it is now feared that the extent of infected soil is much greater than was first assumed. The disease has now been reported from eight estates, and from the evidence available, the infected areas are much larger than the general appearance of the bushes suggests.

Goodey, in his book 'Plant Parasitic Nematodes' gives a list of over 50 species known to be attacked by *A. pratensis*, but there is very little doubt that further investigations will extend that list considerably. A few inoculation experiments have been carried out, and in all cases the eelworms entered the roots under experiment. The mere entry of the

eelworm into a root, however, cannot be accepted as proof that such a plant is susceptible to attack. Much depends on what happens to the eelworms after entry.

For instance, recently germinated tea seedlings, when the primary roots were 1-2 inches long, were inoculated with a few *A. pratensis*. The seedlings were then planted in soil free from this species of worm and were examined four months later. The place of inoculation was then very apparent owing to the discoloration of the tissues, and numerous discoloured areas were to be seen in other roots developed since planting. In all the discoloured areas *A. pratensis* was found in all stages of development. The discoloured areas were not contiguous but were separated by healthy tissues in which no eelworms could be found.

It is apparent from this experiment that after entering the tea root the eelworms found conditions suitable for growth and multiplication. Later some of the eelworms must have left the root originally inoculated, migrated through the soil possibly along the root, and entered the root system again at other places. There was thus an increase in the number of worms and a spread to other roots.

A somewhat similar experiment was carried out with seedlings of *Desmodium gyroides*, but this time the plants were grown in glass sided boxes. A slight discoloration was observed at each place of inoculation, but the discoloured areas of the infected roots never become more than 1 cm. long and no new points of infection were discovered. On examining the discoloured areas two months after inoculation, eelworms were found within the tissues but they were all dead. This experiment indicates that *Desmodium gyroides* is resistant to attack by *A. pratensis*. The eelworms enter the roots, but die soon after entry. Field evidence strongly supports this conclusion, as healthy *D. gyroides* plants have been observed growing on soil known to be heavily infested.

Tephrosia vogelli proved to be as susceptible as tea, and infection spread to other roots.

Experiments with Grevillea, *Crotalaria anagyroides* & *C. usaramoensis* gave somewhat different results. The eelworms entered the roots and survived, but no new infection, indicating a migration of the eelworms, occurred. There was a large extension of the discoloured areas of the *C. anagyroides* roots, but the extension was less in *C. usaramoensis* and still less in Grevillea.

On several occasions Grevillea roots from known infected soils have been sent to the laboratory, but on no occasion has eelworm invasion been found. It would appear that although Grevillea is not so resistant to attack as is *Desmodium gyroides* it is relatively unimportant as a medium for the propagation of this species of eelworm.

Another experiment was carried out to determine whether *Anguillulina pratensis* could attack roots only near the root tip. The seedlings were grown in observation boxes with glass sides and when a large number of

roots had grown along the glass, the glass was removed and the exposed roots watered with a suspension of eelworms. Infection occurred throughout the length of the white-roots and was not restricted to growing points or root tips. After two months the roots were removed and measured. The total root length was 267 cms. along which were 125 discoloured lesions measuring 41.6 cms. A large number of these lesions were examined microscopically, and in all of them live eelworms were found. Thus 15.6 per cent of the root length was attacked. The largest lesion was 15 mm. long and the average length was 3.8 mm.

Investigations have also been started to determine the effect of various poisons, particularly silver salts, on this eelworm. Eelworms in general are very resistant to poisons and as a rule will tolerate greater concentrations than plants will. Consequently, the work has been undertaken without any very optimistic feelings, but it is too early yet to draw any conclusions from the experiments in progress.

Root Knot.—The root knot eelworm, *Heterodera marioni* was found on the roots of *Grevillea* seedlings. The specimens submitted for examination appeared to have been attacked soon after the seed germinated, as galls were found at the base of the tap root. Most of the smaller roots were destroyed and the seedlings were useless for planting purposes. Root knots have not been observed on the roots of established trees.

The same eelworm has been found on the roots of *Oxalis*, *Drymaria*, and *Pueraria* grown as soil covers. It also occurred on the roots of sunflower (*Tithonia diversifolia*) grown in the laboratory.

Leptothyrium theae.—The presence of the disease caused by the fungus *Leptothyrium theae* is usually indicated by the occurrence of one or more dead shoots in otherwise healthy bushes, usually during the first year from pruning. In the annual report for 1935 (Bulletin 13. p. 29) the same fungus was reported to be the cause of death of young bushes. A few similar cases have been observed this year. In addition, the fungus has been found to cause the death of an old bush after collar pruning. The bases of the new shoots formed after pruning were callused and the cortical tissue of the main stem below these branches was dead. In general the symptoms were very similar to those illustrated in Plate I of Bulletin 13. *Leptothyrium theae* was isolated from the junction of the living and dead tissues.

Root Diseases.—*Armillaria mellea* is not a common cause of root disease of tea in Ceylon. This fungus was found for the first time this year on *Tephrosia vogelii*, intergrown with tea. *Ustilina* was also discovered on another estate, on the roots of the same species. *T. vogelii* therefore appears to be susceptible to all the common root diseases of tea.

Grevillea Leaf-fall.—Very few reports of the leaf-fall disease of *Grevillea* caused by *Phyllosticta* sp. have been received this year. The fungus has been found on the leaves of a few trees on St. Coombs but so far no abnormal leaf-fall has occurred even when climatic conditions were favourable.

Gummosis of Grevilleas.—During the latter part of the year several reports were received from Uva regarding the prevalence of a dieback of the upper branches of Grevillea trees. The upper branches were defoliated and the stems died. In some cases the dieback was not very extensive, but in others the greater part of the tree died. The affected trees were usually young trees, but not every such tree was affected.

Within the green stems just before death, numerous small pockets of gum, reddish-brown in colour, could be found within the cortex close to the cambium. The pockets in older stems often coalesced; the cortex was ruptured and gum exuded. Where the gum had disappeared, probably owing to solution in rain, cracks in the cortex could be easily discerned.

A similar disease of Grevilleas occurred early in 1935 following the drought of 1934 (T.R.I. Bulletin 13, p. 24). It is of interest that the occurrence of the disease this year again followed a drought.

Some trees appear to be more tolerant of drought conditions than others as indicated by their freedom from this disease. It is suggested that the seed from such trees should be used for supplies in preference to that from other sources, in the hope that the progeny of such trees would contain a higher percentage of individuals resistant to Gummosis.

A Tortrix Parasite.—Towards the end of September and at the beginning of October, white, threadlike worms measuring up to 14 cms. long were received from three estates, with the statement that they were found on tea bushes. The worms proved to be members of the eelworm family *Mermithidae*, many members of which are parasitic on insects. All specimens were adult females which had just completed egg-laying or were actually doing so. After egg-laying the specimens kept under observation attempted, or appeared to do so, to bore their way into the soil, but without success. One female was induced to lay a large number of eggs on an agar plate but after three months none had hatched.

In October, another estate sent a consignment of Tortrix caterpillars to the entomologist for examination. Within the box were found two dead worms somewhat resembling those mentioned above except that they were not sexually mature. Amongst the caterpillars was one within which, under the skin, could be seen a coil of what appeared to be the same worm extending the whole length of the body. The tortrix larva was placed on a tea seedling growing in a pot. A few days later the caterpillar was dead but there was no trace of the thread worm. On turning out the soil from the pot two thread worms were found at the bottom of it. When placed on the soil of another pot they immediately began to bore their way into the soil. One disappeared completely in 25 minutes and the other in 50 minutes.

These larval worms were thought to be of the same species as the adults mentioned above, and specimens of both were sent to the Institute of Agricultural Parasitology for identification. Dr. T. Goodey very kindly identi-

fied the adults as *Mermis nigrescens* Dujardin, and for his willing assistance I gratefully tender thanks. Concerning the larvae he writes:—

"I cannot identify the specimens in tube B but on general grounds I should think it is quite likely that they are larvae of *M. nigrescens*. Adult females of this species lay eggs on the foliage of plants and these eggs on being eaten by various insects or their larvae (for example tea tortrix caterpillars) hatch in the alimentary canal and migrate into the body cavity of the host. I believe they will not hatch outside a host; hence your inability to hatch them on the surface of an agar plate after 1 month. It is of course possible that the two specimens in tube B belong to another species of *Mermis* but it is very difficult to determine species on larval character."

It would appear that the females come above ground for egg-laying during wet weather only. The eggs are deposited on leaves to which they adhere by means of fine threads visible at each end of the egg. The eggs are ingested by caterpillars which eat the leaf, and hatch within the intestine. The young larvae then bore their way through the walls of the gut and enter the body cavity where they spend the next period of their life. At this stage they are parasitic on the insect caterpillars and ultimately cause their deaths. On the death of the caterpillars the eelworm larvae emerge and enter the soil where they remain, free living, until mature.

It is very unlikely that these worms are parasitic on Tea Tortrix only. It is more probable that any insect which eats a leaf on which eggs have been laid will become parasitised.

The economic importance of this parasite is unknown but the evidence here reported indicates that it plays a part, even though a small one, in controlling insect pests which eat tea leaves.

C. H. GADD.

Mycologist.

REPORT

OF

THE ENTOMOLOGIST

FOR 1939.

Advisory.—779 letters were received, 865 sent out, and 290 specimen items were sent in for examination and report. 32 visits to estates were made.

Visits.—In June, Mr. J. Vincent, Entomologist, from Mauritius, visited St. Coombs. He was in Ceylon with the object of finding parasites for the sugarcane borer, and the Institute were able to furnish him with several thousand *Trichogramma evanescens* for trial as an egg parasite.

Tortrix.—This pest remained in a quiescent state until the second half of the year, when several estates began to report its presence again, although not in epidemic form, requesting parasites to deal with it. All estates which reported were asked to send in caterpillars, to see whether the new parasite, *Macrocentrus homonae* was present. In nearly every case the result was positive. A request for this parasite was also received from South India, and there was even one from California for use against the orange worm.

Further liberations of *Macrocentrus* were made in Halgranoya and Madulsima, in which places it was doubtful whether it existed.

The range of the parasite appears to be extensive, and there is evidence that it was in the Peradeniya neighbourhood by the end of 1939. The rate of parasitism as determined from collections of caterpillars submitted was usually between 25 and 50 per cent.

Determination of its presence once a week throughout the year have been continued at St. Coombs, and have shown that however rare the host may be, the parasite is always present.

Owing to the impressive record of *Macrocentrus homonae*, in rapid colonisation and ability to deal faithfully with the Tea Tortrix, a recommendation was put up to the Board of Agriculture to suspend the regulations with regard to the control of Tea Tortrix. This was accepted and

passed, and the following extract No. 8,451 appeared in the "Ceylon Government Gazette" of May 12th, 1939 :—

"THE PLANT PROTECTION ORDINANCE, No. 10 of 1924.

By virtue of the powers vested in me by regulation 11 of the regulations set out in Part II of the schedule to the Plant Protection Ordinance No. 10 of 1924, I, Edmund Rodrigo, Acting Director of Agriculture, do hereby rescind the notifications of April 27th, 1928, and April 20th, 1928, appearing in the "Government Gazette" Nos. 7,640 and 7,639, respectively relating to the collection and destruction of Tea Tortrix egg masses, larvae and pupae and the forwarding of such records to the Director of Agriculture."

E. RODRIGO,

Actg. Director of Agriculture.

Nettle Grub.—The acreage attacked, at 3,020, was more than in 1938 (1,946 acres), but was distributed amongst only 10 estates the lowest number so far recorded since 1931. Half the estates adopted spraying as a control measure.

Parasites were plentiful in September and October, the three species recorded were :—

Parasite	Host
<i>Apanteles</i> sp.	{ <i>Thosea cervina</i> <i>Thosea recta</i>
<i>Fornicia ceylonica</i>	<i>Natada nararia</i>
<i>Rhogas</i> sp.	{ <i>Narosa conspersa</i> <i>Natada nararia</i> <i>Thosea cervina</i> <i>Thosea recta</i>

Rhogas is a promising parasite, but is only found in any numbers towards the end of the season, which is taken as from about March to October. Attempts to breed it on other than its recorded hosts, in order to keep it going till well on in the following year have not so far met with success.

Caterpillars which are parasitised turn a golden yellow, and stop feeding after a week. Adult parasites emerge two weeks after this.

The life-cycle of *Rhogas* at an average temperature of 71°F is 3 weeks. At 79°F. the cycle is about 2 weeks. Adults can be kept alive in a cool dark cage, with sugar and water, for at least 7 weeks. They fail to survive short spells in a refrigerator at about 41°F.

The *Tachinid* fly, *Tricholyga sorbillans*, also parasitises *Natada nararia*, its cycle in the laboratory being from 4.5 weeks, and its longevity 5

weeks or more if provided with sugar and water. This parasite is far too catholic in its tastes to be of much value to any one species. The number of different hosts it attacks must be fairly large.

Apanteles bred in the laboratory shows a life-cycle of 22-31 days.

Fornicia ceylonica has steadfastly refused to breed under observation.

Shot-hole Borer.—This pest appears to fluctuate in numbers less than any other, and is always present in areas to which it is climatically suited. Damage sustained, however, is more variable, and becomes more obvious after periods of drought. Owing to its secretive habits, experimental work upon it is rendered difficult and of long duration.

For some time past so many doubtful records of alternative hosts having come to light, it was decided to begin *ab initio* to test all recorded plants and others as well. Up to the present *Xyleborus fornicatus* has not been proved to breed in any plant, with the exception of tea and of a new-comer in the tea garden—*Mimosa bracaatinga*, a Brazilian tree. The work is proceeding, and an account will be published at a later date.

The following plants were tested:—

<i>Acacia decurrens</i>	<i>Grevillea robusta</i>
<i>Achania</i> sp.	<i>Hevea brasiliensis</i> (Rubber)
<i>Albizzia falcata</i> (Moluccana)	<i>Hibiscus rosa-sinensis</i>
<i>Cassia</i> sp.	<i>Lantana aculeata</i>
<i>Cedrella toona</i>	<i>Mimosa bracaatinga</i>
<i>Citrus sinensis</i>	<i>Psidium guajava</i>
<i>Crotalaria usaramoensis</i>	<i>Ricinius communis</i>
<i>Erythrina lithosperma</i> (Dadap)	<i>Spathodia campanulata</i>
<i>Gliricidia sepia</i>	<i>Tephrosia candida</i>
	<i>Tephrosia vogelii</i>

It was found, on the other hand, that beetles (*Xyleborus fornicatus*) from a heavily infested castor stem, after introduction to an uninfested tea bush, attacked it readily. Examination after 76 days showed 26 galleries populated by all stages of the beetle.

It is the opinion of many planters that hard plucking induces a heavier infestation by shot-hole borer than light plucking. This is being investigated by plucking three small plots lightly (bud and two leaves) and three others coarsely (everything above fish leaf). Each plot consists of 10 rows of 200 bushes each. Later on, examinations will be made at intervals of three weeks for the presence of beetle populations.

Another opinion expressed by some is that rested tea is often far more free from shot-hole borer than tea in plucking. This is also being tested.

A further experiment started in 1939 relates to the ecology of shot-hole borer, and is attempting to find whether there is any correlation between the fluctuation of populations and conditions of temperature and humidity.

Another experiment in progress, is an endeavour to find out how much damage, in terms of crop, is caused by the breakage of branches due to the borer. It is hoped to have this complete by the end of 1940. The experiment was started on a group of manurial plots on which it was hoped to obtain additional data in respect of the different treatments employed, but this part of the work had to be given up owing to the unsatisfactory nature of the response of the plots.

As the healing over of entrance holes has sometimes been taken as a criterion of the ability of the tea bush to repair damage, and as observation appeared to show that only a very limited number of holes exhibited this healing, another experiment was started in order to elucidate this point.

The following are results to-date :—

No. of new entrance holes observed	49
No. of holes which healed	8=16%
Time taken by each hole to heal, days, 103, 98, 96, 94, 71, 68, 47, 36.	
None of the other holes had healed at the end of 115 days.	

There is no known method of control, either by artificial systems or by natural agencies that can themselves be applied. Furthermore, there is little likelihood of direct control of the beetle. But so long as the tea bush flourishes, so will the damage inflicted on it be of small account. Most planters give it all the encouragement they can by cultivation and manuring, but seasons of adverse weather are bound to come now and then so that the tea bush cannot defend itself so well. Under such conditions, shot-hole borer damage shows up more than at other times. There is no evidence of an increase in population at such times due to these weather effects.

Phloem necrosis.—The probability that this is a virus disease has led to a checking up of various insects as possible vectors of the disease. As a general rule such insects are mainly to be found among the order *Rhynchotha*, which include the plant bugs, and such kinds as *Aphis*, *Scales* and *Mealy Bugs*.

So far the following have been found in the field :—

Family *Jassidae* (Leaf hoppers) 8 species, including two named varieties, *Eutettix apricus* Melich, and *Neodartus acocephaloides* M. All these fed on tea in the laboratory, but only three of them laid eggs in the tea leaf. In addition to the foregoing, another species has been found on protected plants, but not in the field.

Other families, *Capsidae*, *Flatidae*, *Delphacidae*, *Membracidae*, *Psyllidae* and *Aphidae* are represented by one species each.

The *Coccidae* contain a large number of species known to feed on tea.

No thrips have so far been found in the field, although two species, the black *Heliothrips haemorrhoidalis* and an undetermined yellow one have attacked young tea plants in a plant house. The former was found in the open on tea at least fifty years ago.

The Tea Aphis (*Toxoptera aurantii* Boyer) is far the commonest of the above list—in fact so common as to render the likelihood of its being a vector of Phloem necrosis remote.

Most of the other bugs, besides the *Coccidae*, are unknown and unnamed, and their life-histories are being worked out as far as possible. Actual testing for transmission will be done at a later date in co-operation with the new virus officer.

Scarlet Mite.—Among other pests, Scarlet Mite (*Tenuipalpus obovatus*) was responsible for a certain amount of defoliation, leaving bushes almost bare of leaf. The mites are very small and difficult to see, except with a powerful hand lens.

In the laboratory, 29 successive generations have been observed so far, but no males have been produced.

Red Ants (*Oecophylla smaragdina*).—These ants are sometimes a nuisance on low-country estates, several of which reported them in 1939. They make nests in the tea by using the larvae to web the edges of tea leaves together, making a kind of hollow ball in which they live. They readily attack anyone close by so that when numerous they act as a deterrent to labourers.

Their control is a simple matter, but it must be started early. A pruned field is free from nests, and they accumulate with time. Watch should therefore be kept for the nests, which should be destroyed at once. This can quite simply be accomplished by burning them (a kerosene torch is useful for this if several have to be done) or they can be sprayed with a fly sprayer, and the nest removed.

Local Timber for Tea Chests.—The incidence of the war in Europe has interfered with the supply of wood for tea chests, and to make up for lack of imported timber, some local woods, mainly Albizzia, were being employed on a rising scale.

In connection with this, the question arose as to attack by beetles on prepared timber, as previously chests showing such attack have been rejected by quarantine authorities on this account.

Investigation followed. It seems that as soon as a tree is felled it is liable to beetle attack. But after seasoning and sawing into planks it is not so liable. After planks are planed, bore-holes are easily seen, and such pieces should therefore not be used. On the whole only a small proportion of timber to be used for chests showed such holes.

Treatment by heat or chemicals would be a further protection if wood is not properly seasoned.

There was little evidence of attack on stacks of prepared shooks, even up to two months old, or on chests already made up, and it would seem that inspection of planed wood before making up is all that is necessary to ensure a clean chest.

Identification.—A new parasite of Tortrix was named during the year — *Antrocephalus* sp., a parasite of the pupa. It is evidently very rare, and of no economic value.

C. B. REDMAN KING,
Entomologist.

TABLE I
SUMMARY OF NETTLE GRUB OUTBREAKS IN UVA DURING 1939.

1939	Badulla District*			Passara District			Other Districts**			Whole of Uva		
	Estates affected	Out-breaks	Acreage attacked	Estates affected	Out-breaks	Acreage attacked	Estates affected	Out-breaks	Acreage attacked	Estates affected	Out-breaks	Acreage attacked
January	1	3	89	2	3	82	—	—	—	3	6	171
February	2	4	249	2	2	149	—	—	—	4	6	398
March	1	1	76	1	1	122	—	—	—	2	2	198
April	—	—	—	2	3	140	—	—	—	2	3	140
May	3	3	187	1	2	18	—	—	—	4	5	205
June	2	2	127	2	3	44	—	—	—	4	5	171
July	4	5	261	1	3	15	—	—	—	5	8	276
August	3	3	155	2	4	63	—	—	—	5	7	218
September	3	5	230	2	4	43	—	—	—	5	9	273
October	2	2	144	1	1	5	—	—	—	3	3	149
November	1	1	50	1	3	230	1	1	35	3	5	315
December	3	4	206	2	4	300	—	—	—	5	8	506

* Includes Namunukula.

** Includes Haputale, Madulsima and Lunugala Districts.

TABLE II.—NETTLE GRUB IN UVA, 1931—1939.

Planting District	1931	1932	1933	1934	1935	1936	1937	1938	1939
Badulla									
Average No. of Outbreaks per month	7.5	5.3	6.6	5.0	3.5	4.0	3.9	2.5	2.8
“ acreage affected “ “	373	439	333	217	143	236	176	61	148
Percentage (acreage) infection per month	1.14	1.33	1.00	0.65	0.43	0.71	0.53	0.19	0.47
Passara									
Average No. of Outbreaks per month	7.0	4.0	4.5	7.5	9.0	4.4	4.8	2.8	2.8
“ acreage affected “ “	727	390	250	251	229	210	222	94	101
Percentage (acreage) infection per month	7.42	3.98	2.54	2.55	2.32	2.13	2.30	1.00	1.07
Haputale and Haputale West									
Average No. of outbreaks per month	2.20	1.0	0.5	0.2	0.25	0.5	1.0	0.09	0.08
“ acreage affected “ “	180	46	22	—	75	6	11	5	3
Percentage (acreage) infection per month	0.74	0.18	0.09	0.2	0.29	0.02	0.04	0.02	0.01
Madulsima and Lunugala									
Average No. of outbreaks per month	2.0	0.2	1.0	0.5	0.5	0.58	0.25	0.58	—
“ acreage affected “ “	101	1	43	5	5	24	2	2	—
Percentage (acreage) infection per month	1.01	0.01	0.43	0.05	0.05	0.24	0.02	0.02	—
Uva									
Average No. of outbreaks per month	18.5	10.7	12.5	13.0	10.0	9.5	9.9	6.0	5.6
“ acreage affected “ “	1381	876	648	773	384	475	411	162	252
Percentage (acreage) infection per month	1.77	1.12	0.81	0.98	0.49	0.60	0.52	0.22	0.34

TABLE III.—NETTLE GRUB RETURNS 1939.

Planting District	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
BADULLA												
46 estates supplied with cards.	21	20	20	20	18	18	19	18	18	20	18	23
Total acreage under tea	20	18	19	20	15	16	15	15	15	18	17	20
= 31,686	1	2	1	—	3	2	4	3	3	2	1	3
	89	249	76	—	187	127	261	155	230	144	50	206
PASSARA												
9 estates supplied with cards.	8	8	7	7	7	7	7	7	7	7	6	7
Total acreage under tea	6	6	6	5	6	5	6	5	5	6	5	5
= 9,447	2	2	1	2	1	2	1	2	2	1	1	2
	82	149	122	140	18	44	15	63	43	5	230	300
MADULSIMA												
(Including Lunugala)	8	9	8	9	7	8	7	7	7	7	7	7
14 estates supplied with cards.	8	9	8	9	7	8	7	7	7	7	7	7
Total acreage under tea	—	—	—	—	—	—	—	—	—	—	—	—
= 10,654	—	—	—	—	—	—	—	—	—	—	—	—
HAPUTALE												
(Including West Haputale)	15	15	12	14	16	13	12	12	12	12	11	11
42 estates supplied with cards.	15	15	12	14	16	13	12	12	12	12	10	11
Total acreage under tea	—	—	—	—	—	—	—	—	—	—	1	—
= 22,065	—	—	—	—	—	—	—	—	—	—	35	—
UVA												
(Above districts only)	52	52	47	50	48	46	45	44	44	46	42	48
111 estates supplied with cards.	49	48	45	48	44	42	40	39	39	43	39	43
Total acreage under tea	3	4	2	2	4	4	5	5	5	3	3	5
= 73,852	171	398	198	140	205	171	276	218	273	149	315	506
Percentage (acreage) infection per month	0.23	0.54	0.27	0.19	0.28	0.23	0.37	0.30	0.37	0.20	0.43	0.69

REPORT

OF

THE PLANT PHYSIOLOGIST

FOR 1939.

Staff.—The Plant Physiologist proceeded on leave on March 1st. On the outbreak of war he was mobilised under the Royal Army Reserve of Officers. The supervision of the department has been shared by the Mycologist, who has been concerned with the more strictly botanical aspects, and the Agricultural Chemist who has taken charge of the field work.

Advisory.—194 letters were received and 228 despatched.

Wartime Reorganisation.—The absence of the senior officer for an indefinite period has necessitated a reorganisation of the work of the department since it would be impossible to develop all the lines of investigation to which a whole-time officer could devote his attention. Two of the field experiments on pruning, viz. (1) that devoted to studying the effect of time of pruning and (2) an experiment on different methods of bringing young clearings into bearing, were approaching the end of the planned programmes. These experiments have been discontinued, and a report on their results must needs await a more favourable season. The volume of work on selection has also been curtailed in some directions notably by discontinuing the expansion of such work to outside estates. The selection work at St. Coombs is being prosecuted without any diminution, and the report that follows will suffice to show in what ways progress and extension are being made.

Selection — Yield.—At the time of writing, approximately two thousand five hundred bushes selected in the field for size and vigour of growth have been placed under examination for individual yields.

These are made up as follows:—

Yield records completed	...	1,482
Yield records in progress	...	1,007
Total	...	<u>2,489</u>

From these 38 possible clone mother bushes have been chosen.

The standard test is excellence of yield over forty pluckings at weekly intervals. The plucking rounds are divided into five groups of eight and on the completion of each group the yields are ranked in order of merit, so that those at the lower end of the table can be discarded. It is possible that some bushes of intrinsic merit may be overlooked in adopting this procedure because 8 pluckings may be too short a time in which to assess a bush's productivity (especially after a pruning operation). But the essence of selection is that it should be uncompromising, and this continuous rejection of the lowest yielders at each stage enables a much larger number of bushes to be put through a trial.

Originally the plan was to reject as follows from every hundred bushes under trial.

		8th	16th	24th	32nd	40th
		Plucking	Plucking	Plucking	Plucking	Plucking
	Start	1st Discard	2nd Discard	3rd Discard	4th Discard	Final
Rejected	0	25	19	14	10	22
Retained	100	75	56	42	32	10

At each rejection 25 per cent of the existing bushes were discontinued in the yield records till finally the best ten were selected from the final group. This method of selection involves 2,440 bush pluckings at various times. When the first series of bushes had completed their forty rounds an examination of the records was made to decide whether any improvement could be made in the scheme of rejection.

Table I gives the rank at the end of each group of eight pluckings, and the final yield of the best eleven bushes from a series of one hundred that were put under test at the same time. It is evident that bushes may behave quite differently during the course of the plucking rounds. No. 1,118 which finally leads in yield started as low in the list as twenty-nine for the first group plucking. On the other hand Nos. 6 and 1,049 maintained a favourable position throughout the test.

According to the rejection scheme outlined above, after the 16th plucking there are still 56 of the original 100 bushes in plucking. A glance at Table I, however, shows that of those bushes that finally ranked best, none was lower than twenty-third at the second discard. This is indicative that a much more stringent rejection could be made in the early stages. The following rejection scheme was therefore tried:—

	Start	1st discard	2nd discard	3rd discard	4th discard	Final
Rejected	0	50	25	8	6	—
Retained	100	50	25	17	11	11

TABLE I
RANK AND YIELD OF BEST ELEVEN
PER CENT SELECTED BUSHES

Bush No.	Rank at various pluckings					Total Yield Dry Wt. in gms
	at 8th	16th	24th	32nd	40th	
1,118	29	23	12	2	1	260
6.	5	11	4	6	2	259
946	17	3	1	1	3	255
1,158	46	15	2	3	4	254
997	3	3	7	4	5	251
1,049	2	6	15	7	5	251
966	24	17	5	9	7	247
908	14	11	8	9	8	246
1,135	29	7	3	5	9	240
919	24	32	22	23	10	238
345	9	17	15	16	10	238

In this case the standard of rejection is 50 per cent in the first two discards and thereafter 33 per cent. The bush pluckings are 1,712 a reduction of thirty per cent. Examination of Table I shows that with this severer criterion of rejection bush 919 would have been rejected at the second discard since nothing lower than the 25th rank would have been retained. Similarly No. 345 would have disappeared after the 32nd plucking. These two bushes were at the lower end of the final eleven chosen and their loss is of no importance. The saving of time and energy in reducing the number of bushes to be plucked, more than compensates for their removal. The fact that no information of value is lost by stringent rejection is confirmed by examination of the final yields from a number of group selections.

The final yields in Table I show remarkably little difference between the highest and the lowest (8.5 per cent). In other cases there is a marked difference. Table II shows another set of bushes selected by the old discard ratio, and their yields. The final column indicates those which would have been retained or discarded according to the new procedure.

TABLE II
COMPARISON OF OLD AND NEW DISCARD
RATIOS ON FINALLY SELECTED BUSHES

Bush No.		Yield	Retained or Discarded
1,114	...	586	R
1,128	...	487	R
1,054	...	404	R
998	...	377	R
1,095	...	360	D
1,061	...	358	R
1,059	...	357	D

At first sight this comparison seems less favourable than that of Table I inasmuch as we have lost bush 1,095 and retained 1,061 which is lower on the list. But the difference in yield between them is negligible. In this group the difference between the highest and lowest is nearly forty per cent. The bush ranked first on the list is nineteen per cent better than its nearest competitor. Obviously in this case the retention for propagation as clones of the rest of the final group is of very doubtful value. On the average about 2 per cent only of the bushes placed under trial are outstanding in yield, and this figure has been adopted instead of ten per cent as a working norm for selection.

Quality.—Yield is only one criterion of excellence that needs investigation. It is the simplest to place on a routine basis and is therefore selected as the first criterion for the thinning-out process. With the development of a technique for individual bush manufacture by the Biochemical Department (*q.v.*) yield selected bushes are now being put through a quality test for elimination. This test is of supreme importance. Looking forward to the time when the tea fields will be planted with material derived in one way or another from clonal stocks, it would be disastrous if those fields were uniformly high in yield, but equally uniformly low in quality. For example, in last year's report (Bulletin 19 p. 22) a bush was mentioned which consistently failed to ferment from lack of enzyme. When leaf from such a bush is manufactured along with other bushes containing the enzyme (as is the case now in fields of mixed type) no great harm is done. But if a clonal stock of this bush were manufactured the effect would be far otherwise. Consequently on all selected bushes occasional manufactures over a period of six months are being

carried out. These manufactures are done on about twice as many bushes as are likely to be chosen for reasons of yield, so that, if the highest yielders should prove of poor quality, alternative choices are available.

Propagation.—The use of peat-moss as a medium for rooting of cuttings has improved the efficiency of vegetative propagation considerably, but much remains to be done in improving the technique in the later stages. The mortality of rooted cuttings planted direct into the field is very high even in the best of weathers. It is undesirable to spend time, energy and space on the initial process and then lose plants later. Accordingly we have started to transfer the rooted cuttings to baskets in order to produce a hardier plant for eventual transference to the field. Even this milder treatment is not at present satisfactory. Young rootlets die back on removal of plants to the baskets, and, in the weather that has prevailed at St. Coombs during the last quarter of the year, the incidence of insect pests such as thrips, which do not usually cause substantial damage even in tea nurseries, has been sufficient to deprive the plants of their newly-formed leaves. This is more serious for a rooted cutting than for a seedling. The latter has in its seed a reserve food supply available for the production of new growth. The cutting has none: it is dependent on the day-to-day activity of the photosynthetic process in the single original leaf, and since the efficiency of this leaf is not high, the odds are against the survival of a plant so attacked. The raising of cuttings is a delicate process needing care and patience. It is in this direction that the estates can be of most use. If Superintendents experiment with the subject, testing out various ways of raising the basket plants at various stages of rooting, there is no doubt that an efficient technique will be discovered. The larger the number of attempts and variations, the quicker will be the arrival of success. It is a task at which any knowledgeable gardener has as good a chance of success as the scientist, or better, and we should like to commend it to a wide public. A strict record of the percentage of survivals would be needed at all stages in order that a reliable opinion on the best method could be given.

Budding.—The results of the experiment mentioned in the last annual report are complete. Weekly grafting of buds onto their own stocks was carried out for a year in order to see whether any particular season was more suitable than another for the work. The monthly percentages of successful grafts are given below:—

TABLE III

PERCENTAGE OF SUCCESSFUL BUDGRAFTS

Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
15	18	25	18	22	43	24	41	47	51	56	41

The results are poor, especially when it is considered that the grafting of a scion on its own stock is the easiest union possible because it involves no incompatibility such as frequently occurs in commercial grafting. The results show a higher percentage of successes in the period corresponding to late S.W. monsoon and N.E. monsoon weather, *i.e.*, in periods preceded and accompanied by active growth. Some reserve attaches to this interpretation as it is quite possible that increasing skill in the budding operation played a part.

T. EDEN

Acting Plant Physiologist

REPORT

OF

THE AGRICULTURAL CHEMIST

FOR 1939.

Staff.—The staff of the department has remained unchanged. From March 1st the Agricultural Chemist has had the oversight of the field work of the Plant Physiology Department. In September he supervised the field work of St. Coombs Estate during the Acting Superintendent's period of military service.

Advisory.—584 letters were received and 520 replies despatched. The main lines of enquiry have covered manuring, cultivation and weeding and have been closely related to the investigations on these subjects carried out by the department. Particularly in giving manurial advice, the nine years' continuous experiment on the fundamental aspects of manuring has reached a stage of real usefulness. The indications are quite definite that companies, agents and superintendents are looking more and more to the Institute for independent advice, based upon the results of investigations conforming to an internationally accepted standard of accuracy and credibility.

The question of manuring has occupied a great deal of the senior officer's time, particularly since the outbreak of war. As far back as September, 1938 the Institute had put on record its views regarding fertilizer shortage in the event of war, and during the year under report these were communicated by way of the Planters' Association to the Ceylon Estates Proprietary Association and to the firms responsible for the import and distribution of fertilizers. At a joint conference in October the whole question was reviewed by the Planters' Association, the Ceylon Estates Proprietary Association, the Low-Country Products Association, the three Research Institutes and the mercantile interests, when an agreed voluntary rationing scheme was decided upon. So far, the business of prescribing suitable mixtures from available supplies in an equitable manner (whilst conserving stocks of fertilizers that are for the time being unobtainable) has worked well, and has inflicted little hardship upon consumers beyond an inevitable rise in price due to the necessary use of dearer constituents. The rise in price has been very moderate, existing stocks being marketed at pre-war prices. For the first three months only 50 per cent of the normal quantity of sulphate of ammonia was released, the balance of nitrogen being made up with cakes and offals from India. Special shipments of nitrate of soda have since enabled the inorganic

portion of the nitrogen to be extended, whilst conserving sulphate of ammonia, and a more favourable cost per acre maintained. The Institute has been able to reassure users regarding dilution with the 'physiologically' alkaline nitrate of soda, an important consideration being the known preference of tea for acid conditions of soil reaction. There is no reason for complacency as to manurial supplies, but the liaison established on the Institute's initiative between all interested parties ensures that the disposal and use of supplies, as they become available, will be in the common interest.

Sub-Stations.—Visits to sub-stations being now a matter of ordinary routine, special mention of them is unnecessary. Certain alterations were made in the administration of experiments at outstations as a result of war conditions, and the Wikiliya trial of compost and green manuring was closed down at the year end. The detailed results will be recorded in future publications, but nothing has emerged to alter the trend of results reported in last year's annual report. The main points are relative inefficiency of all forms of nitrogen, including compost, in the dry zone, a problem that will have to receive further attention.

Lectures.—Apart from a contribution to the Institute's biennial conference, only one lecture was given dealing with the war-emergence use of fertilizers.

Publications.—"The Use of Composts and Green Manures with particular reference to Tea Estates," T. Eden and J. G. Shrikhande, *Proceedings of the Society of Biological Chemists, India*, 1939, Vol. IV, 18-26.

"Nitrite Estimation in Composts and Soil Extracts," J. G. Shrikhande, *Current Science*, 1939, Vol. VIII, 369.

Decomposition of Green Material.—In the last annual report there was a brief reference to the fact that the decomposition of tea pruning leaf was anomalous in that the transformation of protein nitrogen to mineral nitrogen (ammonium compounds and nitrate) was apparently impeded. The results pointed to the possibility of the nitrogen being converted to nitrogen gas and thus lost. The significant point of this possibility lay in the fact that the conditions of decomposition were aerobic, though normally losses of gaseous nitrogen are associated with an anaerobic fermentation.

During the past year Dr. Shrikhande has put the matter to a more stringent test. In a series of experiments, standard quantities of *Gliricidia* leaf and tea pruning-leaf of known nitrogen contents were decomposed in sealed bottles through which a stream of ammonia-free air was passed continuously for a period of some sixty days. After passing through the decomposing material, the air stream was bubbled through U-tubes holding known quantities of acid of known strength. Any ammonia formed as a result of decomposition was retained by this acid. Every few days the extent of neutralization of the acid by ammonia was determined and the tubes replenished with fresh acid. The progress of ammonia absorption was watched by addition to the acid of an indicator solution which

changed from red to yellow as neutralization proceeded. At the end of the experimental period the decomposed material was analysed for ammonia, nitrite, nitrate and organic nitrogen: the total quantity of evolved ammonia was also known. Thus it has been possible to construct a balance sheet of nitrogen before and after the experiment, and to include in that balance sheet all the various forms of nitrogen except nitrogen gas. The results provide further presumptive evidence of the loss of nitrogen in gaseous form under undoubtedly aerobic conditions. An example is given in Table I.

TABLE I

BALANCE SHEET OF NITROGEN IN PLANT MATERIAL
AFTER 63 DAYS' DECOMPOSITION
(Percentage of dry matter)

	Nitrite	Nitrate	Ammonia	Residue	Loss	Total
Tea	nil	nil	0.019	2.700	0.251	2.970
Gliricidia	nil	nil	2.200	1.850	-0.030	4.020

All the figures except those in the column headed loss were obtained by direct analysis. The first four columns relate to the material after decomposition: the figure for total nitrogen is that of the material at the start of the experiment. It will be observed that the balance sheet has been satisfactorily closed in the case of gliricidia. The loss is given as a negative one, *i.e.*, the categories nitrate, nitrite, ammonia and residue actually add up to slightly more than the determined initial amount. This is due to small experimental or sampling errors, but the discrepancy is only of the order of three-quarters of one per cent. Tea on the other hand shows a loss of nearly 8.5 per cent. The near approximation to a closed balance sheet on the part of gliricidia indicates that the loss observed with tea, under otherwise identical conditions of environment and technique, is a real one and not merely experimental error. A further point of interest is that only 9 per cent of the total nitrogen in the tea has undergone decomposition into simple substances, whereas for gliricidia the corresponding amount is 64 per cent.

The further investigation of this type of fermentation presents some difficulty as our equipment at St. Coombs suffers from unavoidable disabilities when certain kinds of work are contemplated. The only satisfactory rounding-off of the first stage of the problem would be to collect and measure nitrogen actually produced. Without coal gas and facilities for glass-blowing, it is doubtful whether an apparatus of sufficient accuracy and delicacy can be assembled, but the matter is receiving attention.

Nitrogen Losses from Mixed Fertilizers.—It is a commonplace that certain fertilizers must not be mixed on account of chemical reactions that may take place between them when in close contact, particularly if they are damp. The general principle is that ammonium salts should not

be used in conjunction with manures containing free lime or other alkaline constituents, since under these circumstances the ammonia is released and lost as gas. During the past year the action of mineral phosphates has been called into question. These contain very little free lime, but certain forms of calcium phosphate have been shown to be capable of decomposing ammonium salts.

All chemical reactions are influenced by the prevailing conditions of moisture, temperature and fineness of division of the reagents involved. These conditions will obviously depend on the conditions of storage of manure mixtures, and a reaction that would be rapid in small parcels of manure might be negligible in large amounts. The surface of a bag does not increase at the same rate as its volume. Large bulks therefore are less susceptible to moisture effects than small bulks. Much of the work on fertilizer storage has, for obvious reasons of economy and ease of working, been done on small lots so that the evidential value of these investigations is doubtful.

With these considerations in view the Tea Research Institute in conjunction with the Coconut Research Scheme carried out a comprehensive investigation of the effect of mineral phosphates on nitrogen losses from mixed fertilizers. Five different sources of phosphate were tried in order to see whether some were preferable to others. Two kinds of sulphate of ammonia were used, ordinary finely ground granulated and 'rice crystal,' the latter representing a rather coarser and probably less reactive type than the former. Mixtures habitually contain muriate of potash, a salt which readily absorbs moisture from the atmosphere. Varying quantities of this might therefore greatly affect the uptake of moisture on storage, with consequent acceleration of ammonia loss. Two rates were accordingly tried. Finally, a conditioner such as castor cake, which is not chemically reactive, tends to separate the particles of the other constituents one from another, and thus has an ameliorative effect. Moreover, being an oil seed, it is capable of protecting the particles of the other fertilizers by covering them with a partial film of oil. A series with conditioner and one without were tried. Every combination of these types of treatment, making forty separate mixtures in all, were examined in 25-lb. lots. As an added precaution one series was done in samples of commercial size and, since the work was carried on both at St. Coombs and Bandirippuwa, one laboratory phosphatic series was duplicated in both places for the same reason. Otherwise the Coconut Research Scheme specialized on mixtures adhering to ratios of nutrients used in their industry and the Tea Research Institute similarly restricted its work to tea crop mixtures.

The results of this investigation of wide scope definitely indicated that there was nothing to be feared from the storage of mixtures of the type commonly in use. No loss outside the limits of the sampling error of the experiment occurred in tea mixtures kept for sixty days, although the moisture contents rose as high as nine per cent. This was higher than the values attained by commercial samples stored in Colombo. The comparison of the 25-lb. samples with the commercial samples showed that whilst the former were done under rather more stringent climatic con-

TABLE II
Effect of Various Phosphates on Nitrogen Loss in
Mixed Fertilisers.

Percentage Moisture and Nitrogen Contents (on dry weight).

TEA SERIES									
	Initial		Tenth day		Thirtieth Day		Sixtieth Day		Mean Total Gain or loss of Nitrogen
	Moisture	Nitrogen	Moisture	Nitrogen	Moisture	Nitrogen	Moisture	Nitrogen	
Saphos A	0.18	10.49	1.69	10.76	2.84	10.74	7.40	10.60	+0.11
Saphos B	0.32	10.78	1.98	10.78	2.31	10.48	6.72	10.71	-0.07
Gafsa	0.14	10.38	2.48	10.64	2.32	10.55	8.39	10.64	+0.26
Ephos	0.25	10.52	2.14	10.68	2.59	10.75	7.77	10.73	+0.21
Egyptian	0.41	10.64	2.63	10.57	2.70	10.68	9.11	10.68	+0.04
Differences necessary for significance between losses (N) for different types of phosphate									+0.11

ditions, they offered a perfectly fair basis for judgment on this matter. There was no significant difference between any of the treatments tried, which varied in phosphatic type, potash concentration, granulation or presence of conditioner. There were indications that on long storage some of the protein in the conditioner became soluble and its nitrogen would then be estimated as ammonia but that is a point of chemical rather than practical interest. Although the conditioner had no chance of showing its effect on nitrogen loss, since there was none, its use was shown to be thoroughly justified in practice. After storage even for ten days, mixtures omitting a conditioner had to be broken up before it was possible to put them through a sieve in preparation for sampling. Mixtures containing ten per cent by bulk of conditioner broke up in the hand or on the sieve without trouble. Conditioners are therefore well worth while as an aid to efficient distribution. The results for the full tea series are presented in Tables II and III.

TABLE III
LOSS OF NITROGEN FROM MIXTURES
Classified According to the Non-Phosphatic Ingredients

			Differences between variously constituted mixtures. Tea Series.
Rice crystal minus Granular	...	...	+0.124
Double Potash minus Single Potash	...	...	+0.038
With Conditioner minus No Conditioner	...	...	+0.062
Significant difference	...	...	0.189

Pruning Mixtures.—Further evidence has been accumulated on the subject of the effectiveness of delayed application of the pruning mixture. At the end of the current year, the pruning cycle of the manurial experiment had already run 32 months. The plots that had been manured (in the pruning year only) three and six months respectively after pruning were substantially ahead of those manured at pruning time. Those subject to a three-month delay consistently increased their lead over the latter up to the twenty-fourth month after which, making allowance for the experimental error of the trial, the gain became stabilized at forty-five pounds an acre. Those manured as late as six months after pruning are even now not merely maintaining their gain, but are enhancing it and show a superiority of just over 100 lb. per acre. The point of interest is that manuring, subsequent to that in the first year, was carried out on all plots at the same time, but did not have the levelling effect that might have been expected. The conclusion seems inevitable that the more efficient use of the delayed manurial application has produced bushes capable of dealing more efficiently with succeeding applications.

The most comprehensive physiological work on the movement and synthesis of nitrogen in the plant (Maskell & Mason on Cotton) concludes that "the bulk of the mineral nitrogen absorbed by the roots is carried in the transpiration current to the leaves, where it is elaborated to amino acids etc. and then exported through the sieve tubes back to the roots etc." In other words the leaf is the place where the manufacture of complex nitrogenous compounds from the simple forms imbibed by the roots, starts. The results of our experiments are in accord with this physiological principle. Whatever nitrogen is taken up during the leafless stage after clean-pruning produces no measurable effect in the economy of the plant up to tipping time. When other types of pruning are considered the presence of a variable quantity of residual leaf may reasonably be conjectured as affecting the use made of nitrogen imbibed immediately after pruning. This hypothesis has been put to the test during the present year. An experiment, replicated tenfold, was set up on pruned tea with a generous residue of 'lungs' on an estate in Uva, and the records were taken by the staff of the Passara Sub-Station. Four treatments were included, (1) no Manure. (2) Estate mixture (Nitrogen 35 lb., Phosphoric acid 26 lb., Potash 10 lb.) applied at pruning time, (3) Estate mixture at the end of 2 months, (4) Estate mixture at the end of 4 months. The date of pruning was July 11th and manuring was carried out on July 18th, September 17th and November 17th respectively. Tipping was done on November 8-9th, November 29th, and December 21st. The weather was fair and the tipping yields were weighed green. In addition, the new growth on the 'lungs' was cut off and also weighed. The mean plot yields are given in Table IV.

TABLE IV

EFFECT OF TIME OF MANURING ON 'RIM-LUNG' TEA

Green Weight Yields in lb. of Tippings and New
Growth on Lungs.

	Nil	At pruning	Manurial After 2 months	Treatment After 4 months	Significant difference
Tippings lb.	43.3	44.5	42.0	42.4	3.5
Per cent of mean	101	103	98	98	8
New lung growth lb.	44.7	48.7	44.9	46.6	9.4
Per cent of mean	97	105	97	101	20

The figures in the last column give the amounts in lb. and per cent by which any two treatments must differ for that difference to be ascribed to treatment and not merely to chance. None of the differences is significant; at tipping time none of the treated plots shows any superiority over that which has not been manured. If sufficiency of leaf were the only factor affecting response to pruning mixtures, this negative result would have been distinctly unlikely. It becomes apparent therefore that

some additional factor is operative. It is not climatic, since the period of the experiment was one of normal rainfall. The possible factor selected for further investigation is that any considerable degree of pruning causes the root system also to be put out of action to a considerable degree. We do not suggest that pruning causes an actual dieback of feeding roots, but that their physiological activity may be markedly decreased. An investigation into this aspect of the problem is in preparation.

This whole question of manuring in relation to pruning is a good example of how an investigation develops. It is now eight years since the first piece of evidence was obtained throwing doubt on the traditionally accepted theory of the efficiency of 'pruning mixtures.' Step by step the experimental evidence has been sought and accumulated. Each new approach has confirmed the new general principle whilst at the same time narrowing the search for the causative agent. On two occasions already dealt with in this report, viz. the response of tea receiving delayed manuring to further manuring, and the response of rim-lung pruning to delayed manuring, perfectly reasonable explanatory hypotheses current in our minds have been rejected and a new line of attack suggested. The investigation shows clearly how mistaken may be the most plausible armchair explanations if unaccompanied by direct experimental proof.

Cultivation and Weeding Experiment.—This experiment, of which details have been given in previous annual reports, completed its first three-year cycle during the current year. The results to date were dealt with in a paper at the Institute's Conference and consequently will not be enlarged on here. For the sake of completeness the average yields for the main treatments for the whole cycle are tabulated in Table V.

TABLE V
EFFECT OF CULTIVATION AND WEEDING
ON CROP YIELD

Lb. Per Acre Per Annum for 3-Year Pruning Cycle

	Intensive cultivation (3 times per annum)	Normal cultivation (Once per annum)	Clean weeding	Selective weeding	Significant difference
Yield per acre	520	549	558	512	23
Per cent. of mean	97.3	102.7	104.3	95.7	4.3

The effect of weeds and intensive cultivation has been small, but the accuracy of the experiment is such as to leave no doubt as to their validity.

A further point that has emerged from the work that was carried out in association with this experiment has not so far been reported. It concerns the effect of rainfall on the stability of soil tilth produced by cultivation. It has been pointed out previously that the treading of the cultivation rows by labourers performing the recurrent operations of plucking, pruning and weeding, produces a compact surface layer of soil some two to three inches deep which is a potent factor in the production of surface run-off and consequent soil erosion. This denatured soil surface is produced the more readily when the soil is heavily laden with moisture. But the measurements of soil resistance by means of the Culpin soil-probe on areas where no treading has taken place show that the action of rain by itself plays little or no part in destroying the crumb-like structure of the soil. The traces recorded by the probe for the resistance of the soil to penetration at successive depths, after seventeen months' exposure to the weather, were, as nearly as makes no matter, identical with those taken immediately after the cultivation of the area. This appears to be in marked distinction to the behaviour of soils in temperate climates for which similar records are available. There are reasons for supposing that this difference in behaviour on the part of the soil under survey in these experiments may be common to all old tropical soils generated *in situ*.

FOOD PRODUCTION.

The Institute has taken part in the consideration of methods of increasing the cultivation of home-grown food crops in time of war. The problem is hedged with difficulty on all sides. The most serious obstacle is the scarcity of suitable crops and the shortage of seed sources for such as can be grown.

Estates with open areas for food production are virtually working in the dark, since crop trials in up-country climates have not been carried out as part of the experimental policy of the Department of Agriculture. On consideration it was thought that the most appropriate contribution we could make would be to test the suitability of such crops as were available. The planting season at which this work must needs be started, if time was not to be lost, had already arrived when this decision was taken and for this reason alone, trials had to be restricted to small nursery demonstration beds. That this was a wise decision on other grounds, notably the aforesaid ignorance as to which crops would grow at these altitudes, has been shown by the subsequent history of the trials.

The following crops were planted :—

Cereals.—Maize (*Zea mais*)

Adlay (*Coix lachryma-jobi*)

Kurakkan (*Eleusine coracana*)

Bulrush millet (*Penisetum glaucum*)

Hill paddy (*Oriza sativa*) varieties.

Suwandel elwi	124 days
Nuga elwi	125 „
Gana baru	125 „
Sudensamba elwi	121 „
Polayal W.K.	121 „
Siwuru elwi	121 „
Ranel	110 „

Legumes.—Cowpea (*Vigna sinensis*)Soya bean (*Glycine max*)

Varieties :—Chame.

No. 459.

The trials have been subject to both insect attack and drought. The most promising cereal is Bulrush millet which germinated, tillered and produced flowering heads within two months of sowing. Maize also grows satisfactorily and there is a possibility that some of the hill paddies may be suitable. Kurakkan and adlay are definite failures. The potentialities of soya bean cannot be decided till later. But it is evident that inoculation with the appropriate symbiotic bacterium is necessary for success.

Attention in future is to be devoted to the establishment of a suitable number of rotations, and an experimental opening of 2 acres is in process as a demonstration of inexpensive means of establishing anti-soil erosion protection. This will be planted in root crops on the arrival of the rains.

T. EDEN,
Agricultural Chemist.

REPORT

OF

THE BIOCHEMIST

FOR 1939.

Staff.—The Biochemist returned from home leave on 1st July and was absent, on military duties, during the whole of the month of September during which time the Director again took charge of the Department.

Correspondence.—272 inward letters were received and 237 despatched.

Visits.—After returning from leave the Biochemist was away on seven occasions for advisory and investigational purposes, including a week spent in connection with various aspects of the local tea chest industry.

In England, the Biochemist made a number of visits to Mincing Lane, mainly in connection with Clivemeare teas. A day was spent at Messrs. J. Lyons & Co's Factory at Greenford and a further day at Messrs. Robertson & Co's Works at Bedford where the design of the Clivemeare machine was discussed. Two visits were made to Messrs. J. Lyons & Co's Laboratories. Two days were spent at Messrs. Marshall's Tea Machinery Co's Works at Gainsborough. A projected visit to Messrs. Davidson's Works at Belfast did not materialise owing to a postponement which was intended to defer the visit until Messrs. Davidson & Co's Chief Engineer in the Tea Machinery Department returned from the East.

Tests with a Lovibond colourimeter designed to facilitate measurements of colour and brightness of tea liquors and infusions were also arranged for and carried out in Mincing Lane.

Acknowledgments of the kind assistance and hospitality received during these various visits appear in the final section of the report.

ANALYTICAL.

1. 19 moisture determinations were made for various outside estates.
2. Determinations of the moisture content of 77 invoices and 806 samples of withered leaf were made for St. Coombs Estate.

3. Samples of scrapings from a roll breaker, scale from a furnace, tea chest wood, and commercial teas were analysed for various specific purposes.

4. Samples of water supplied to the laboratory, factory, bungalows, and lines have also been examined in this Department.

Manurial Experiments.—In conjunction with the Agricultural Chemistry Department's manurial experiments, 112 samples of leaf were examined for soluble matter, tannins and pectins. The Agricultural Chemistry Department is determining ash, nitrogen, potash and phosphate contents of the same samples. Meteorological data such as sunshine, rainfall, etc. are all available, and leaf from the plots from which the samples have been drawn has all been manufactured on a comparative basis. The combined data should yield some valuable information.

BIOCHEMICAL

Considerable progress has been made in this branch of the Department and a paper is being prepared for publication in a scientific journal. Contact has been maintained with the Tocklai Experimental Station where parallel work is in progress and a joint letter sent to *Nature* which was published in the issue dated 18th November, 1939. There is still some difference of opinion between the two stations about the exact nature of the enzyme system responsible for the oxidation of the tannins and other polyphenols of tea. Recently, the presence of a endo-enzyme system in tea leaf reported by St. Coombs has been confirmed at Tocklai and one of the major differences explained.

As a result of these controversial results it has been necessary to estimate the amount of ascorbic acid (Vitamin C) in Ceylon tea leaf. The amount varies between 0.14 mgs. and 0.45 mgs. per gramme of fresh leaf and is almost completely destroyed by firing. In view of the present intention to publish a paper, which has been prepared, on the occurrence and distribution of ascorbic acid in Ceylon tea leaf, as well as on the enzyme system, it is not intended to deal further with these subjects in this report.

GENERAL MANUFACTURE.

Rolling.—Experiments with the Clivemeare roller passed on to the commercial stages and during the dry weather all St. Coombs Estate teas were manufactured for sale in London. Clivemeare and normal manufacture were carried out on alternate days and two comparative invoices sent for sale on the open market. As reported in *The Tea Quarterly*, 1939, Vol. XII, p. 147, the sale average of the Clivemeare invoice was 2.7 pence higher than that of the normally manufactured invoice.

In London the Biochemist had the opportunity of discussing Clivemeare teas with blenders and learned that, provided certain standards of make and weight are maintained, up-country teas manufactured by the Clivemeare process are very desirable from the blenders' point of view. Up-country teas normally tend to lack colour and strength which defect, from the blenders' standpoint, detracts from their all-round value in spite of their high quality. Clivemeare manufacture undoubtedly increases colour and strength and improves infusions without affecting quality to any marked extent, and the resultant tea is more desirable for the blenders' purposes.

The manufacture of six consecutive invoices with the Clivemeare roller was commenced in July, but owing to the incidence of the war and the regulations laid down in regard to tea supplies for the British Government it was found necessary to revert to normal manufacture. One invoice actually reached London and was favourably reported on, but the object of the experiment was to study the reaction of the market to a succession of Clivemeare invoices.

A number of other rolling experiments have been carried out on the experimental rollers.

(a) Long Pressure Periods vs. Short Pressure Periods.

A series of dhool out-turns was pre-arranged and obtained from identical rollers, the pressure in one set being applied for 8 minutes with 2-minute intervals whilst in the other set the intervals were five on and five off.

8 on and 2 off.—London consistently preferred these teas to the average extent of 0.4 pence on six tastings of bulked samples from manufactures spread over the period October, 1938 to September, 1939.

5 on and 5 off.—Colombo opinion was consistent and directly opposite to London opinion. The preference in this case was 0.4 cent.

(b) Twisting Battens vs. Cutting Battens.

In one series twisting battens were employed for the first three rolls and a cutting batten for the fourth. The parallel series employed cutting battens throughout.

Pressures were arranged to give equal big bulk out-turns and were therefore necessarily higher in the case of the twisting battens.

Both London and Colombo preferred the twisting battens, the average premium being: Colombo 1.6 cents, London 0.11 pence.

It is probable that larger differences would have been obtained if the twisting battens had been employed three times with less pressure and the bulk reduced by two applications of cutting battens. As pointed out previously, *Tea Quarterly* (September, 1938) Vol. XI, p. 131, pressure application tends to restrict circulation, and the application of pressure to twisting battens in order forcibly to raise dhool out-turn tends to spoil their action.

Batten action is being studied with a view to overcoming these difficulties as will be explained later.

(c) Short Charging Intervals vs. Long Charging Intervals.

Charging the rollers every 50 minutes as against charging every 100 minutes, was tested in this series. Assuming organised manufacture where the rollers are kept fully employed, this experiment affords a comparison between teas in which the difference between the longest and the shortest fermentation is in one case 50 minutes and in the other 100 minutes.

Colombo tasters did not distinguish between the two sets of teas, but London consistently preferred the shorter over-all firing time to the average extent of 0.4 pence.

As repeatedly mentioned in articles on rolling, it must be fully appreciated that there is a consistent and marked difference in the requirements of the Colombo and London markets. Colombo tasters exhibit a requirement in standards of appearance which is much more rigid than the average London requirement where colour and strength are of more account. Both markets show a lively interest in quality so long as it is combined with the other characters in demand. London tasters appear to show more interest in pungency than do the Colombo tasters. It should be understood that these comments are based on the results of reports on our experimental teas and that we do not consider ourselves competent to report on general market trends. However, the rigid requirements of Colombo tasters with regard to appearance are too well marked to be passed over without comment.

Since the twisting action of normal battens is undoubtedly responsible for the main changes in the rolling process it is considered desirable to study the factors involved in the action. We have been fortunate in receiving a kind offer from Messrs. the Colombo Commercial Co., Ltd. to make for us a number of different type of tables and battens as our experiments progress, and in this we have the very able advice of Mr. F. J. Whithead.

Accordingly we have started from a plain table without battens or obstructions of any kind, and are adding various types of projections starting from the centre of the table where, as previously reported, *Tea Quarterly* (September, 1938) Vol. XI, p. 1936, at the bottom of the page) the larger proportion of batten action takes place.

At the present moment the ideal table appears to us to be one which will allow the application of hard pressure without undue restriction of circulation and consequent tearing and cutting. The dhool out-turn from such a table would be about 20 per cent with pressure full on and would have to be well twisted.

With regard to the application of pressure and the initiation of fermentation, the Clivemeare roller undoubtedly has very considerable merit and must be considered in relation to all these experiments.

Firing.—An account of firing experiments appeared in *The Tea Quarterly*, (December, 1939), Vol. XII, p. 171, and results on experiments on firing temperatures were given in that article. Further experiments on firing to various levels of moisture content were also commenced. Experiments on final firing are also in progress.

Grading.—The results of tests on stamped aluminium sheets with circular perforations were reported in *The Tea Quarterly* (December, 1939) Vol. XII, p. 179.

Storage and Maturing.—A number of further experiments has been carried out to test the effect of moisture absorption on the quality of made tea. Above 3 per cent moisture content there appears to be a linear relation between moisture content and fall in quality.

Short-fermented teas appear to mature for some weeks at 5.5 per cent moisture, but at higher moisture content they deteriorate rapidly. Further experiments are in progress and are combined with firing experiments designed to test firing to different levels of moisture content.

Factory Hygiene.—Further experiments have been carried out in connection with bacterial control by the flaming process. The experiments are still in progress and will be fully reported when reliable data become available.

MANUFACTURE OF LEAF FROM FIELD EXPERIMENTS.

Manurial Experiments. (In conjunction with Agricultural Chemistry Department).—Eleven manufactures have been carried out with leaf from plots of manurial and cultivation experiments in order to test the effects of manuring and cultivation on quality.

Pruning Experiments. (In conjunction with the Plant Physiology Department).—Six manufactures of leaf from plots pruned at different seasons have been carried out by the department in connection with the effect of pruning season upon quality.

Selection Experiments. (In conjunction with the Plant Physiology Department).—The manufacture of leaf from individual bushes selected for high yield commenced during the later part of the year. Up to the end of 1939, 97 manufactures of 44 different bushes were carried out on 24 occasions.

A note on the manufacture of leaf from individual bushes was published in *The Tea Quarterly* (1939) Vol. XII, p. 183.

Acknowledgments.—Mr. Horne of Messrs. Forbes & Walker continued to render very valuable service by arranging for meetings of our Colombo Team of Tasters, and tasting the samples manufactured from individual bushes in connection with propagation work. During Mr. Horne's absence on leave, first Mr. Kane and later Mr. Pelly Fry gave us all the necessary assistance and advice with our experimental teas. These services were of the highest value to us.

In London Mr. E. B. Loudon-Shand again arranged the tasting of our experimental teas and we are much indebted to him for the smooth efficiency with which the samples forwarded are handled.

Upon the tasting of experimental samples depends the whole of our progress with factory experiments and we find it difficult adequately to express our thanks for the assistance so willingly and ably rendered by many tea tasters. In addition to those already mentioned the following have regularly reported on our samples:—

Mr. G. H. Yuille of Messrs. Geo. White & Co.,

Mr. M. P. Saunders of Messrs. Whittall & Co.,

Mr. C. E. Allen of Messrs. Whittall & Co.,

Mr. J. M. Westwood of Messrs. Carson & Co., Ltd.,

Mr. D. F. Armitage of Messrs. Carson & Co., Ltd.

Mr. W. R. A. McLellan of Leechman & Co.,

Mr. H. W. T. Sherwood of Messrs. Harrisons & Crosfield Ltd.

Apart from routine team tasting we have received much valued assistance in other branches of our activities.

Mr. C. Ross-Bridge conducted some very careful experiments with the Hauck Flame Gun in connection with bacterial control in low-country factories.

As described in the section on rolling we are indebted to the Colombo Commercial Co., Ltd. for supplying material for rolling experiments and for giving us the assistance of Mr. F. J. Whitehead.

During the Biochemist's leave in England he received much valuable assistance and kind hospitality and wishes personally to express his appreciation for these, to the following:—

Messrs. Thomson Alston & Co. and Mr. E. R. Corbett who has afforded a great deal of help to the Institute, especially in connection with packing material tests and Clivemeare experiments.

Messrs. W. J. & Henry Thompson and Mr. W. J. Thompson.

Messrs. J. Lyons & Co. and Dr. L. H. Lampitt and Mr. H. Barton.

Messrs. Marshall's Tea Machinery Co. and Mr. and Mrs. W F. A. Ridler

Also to Mr. Clive Meares and Messrs. Robertsons of Bedford.

Finally, as in previous years, I wish to record my personal appreciation of the services rendered to the Department by Mr. F. J. Whitehead

J. LAMB,

Biochemist

REPORT

OF

THE SMALL-HOLDINGS OFFICER,

GAMPOLA, FOR 1939.

The advisory work that has been done among the small-holders since my appointment in 1933, has been centred round three chief headmen's divisions namely Uda-Palata, Udu-Nuwara and Yati-Nuwara.

All three divisions are studded with small-holdings and bought-leaf factories. The number of small-holdings in anyone of these divisions is much greater than one finds in any other province. The numerous tea factories that have been built mainly for the manufacture of leaf from this source prove it.

The majority of people judge the acres of small-holdings and the state of their cultivation by those that are seen by the roadside. I can assure them that the better cultivated and the bigger acreage lies in the heart of the villages, and to judge the productivity of these small-holdings a visit should be made to a bought-leaf factory.

This was one of the reasons why the Institute began its advisory work in these three divisions. Work was first started in Uda-Palata and this was continued for two years. At the end of this period a competition was organised among the small-holders, which helped to create more enthusiasm and to find out how far and how readily the new methods of work were being adopted.

All these competitions have been worked over a period of twelve months, giving the small-holders time to carry out the necessary improvements. The results of this policy have been very successful competitions in which there have been entries from every village in Uda-Palata. Today we have small blocks of tea worked on the methods advocated by the Institute in every village. They serve as excellent demonstration blocks and will, as times goes on, help other small-holders to have similar holdings.

As small-holders very readily responded to the new methods of work in Uda-Palata, a new area was taken over in Uda-Nuwara, another chief headman's division which borders Uda-Palata. The work done during the next two years in this area also proved very successful. Economic conditions were improving every year and small-holders very readily followed instructions and improved their gardens. At the end of this two-year period a competition was run on similar lines to the one held in

Uda-Palata. This test too proved a great success and now we have a greater number of small-holders adopting correct methods in the working of their holdings and setting the pace for others in the villages.

The next two years of work was in Yati-Nuwara ; this division borders Udu-Nuwara and Uda-Palata.

The keenness shown by small-holders in this area too was very encouraging. In fact the response was greater than in the two previous divisions. The average small-holding in tea in this area was in a very much better state of cultivation than in the other two divisions, especially in the Kandu Palata Korale.

At the end of the two years of work the small-holders of this division were also put through a similar test which showed that the standard of work was much higher, and entries larger than in the other two divisions. This brought to a close a number of competitions and concentrated work in three divisions. The co-operation of headmen, V. C. chairmen and members helped considerably in the working of these areas, organising the competitions and obtaining good results.

The work done during the past six years in these three divisions has thus made a useful beginning to a general scheme of advisory work which has met a long-felt want among the small tea growers. Hitherto they have attempted to follow the methods of work done on larger estates but without guidance.

It is now our object to do more concentrated work in smaller areas within these three divisions, and help as many small-holders as possible to work their holdings on correct lines. This affords more time to revisit the areas that have already been worked and for any special work. For this purpose competitions are being organised in the different korales in the three divisions, taking at a time two korales from different divisions.

These competitions are also being run on similar lines to those in the divisions. The response has been good and we were able to bring to a close the first of such competitions in May this year. The areas worked were Kandu Palata Korale in Udu-Nuwara and Kandukara Pahala Korale in Uda-Palata.

The final judging was done by Dr. Norris, the Director of the Institute. There were 131 competitors. The distribution of prizes and certificates to the successful candidates was held at the Kirinde Government School. Dr. Norris very kindly consented to give away the prizes. There was a large gathering of small-holders present from the two Korales, including the Ratamahatmaya of Uda-Palata.

Demonstration Work.—These competitions help considerably to spread the improved methods of work advocated by the Institute into every village and demonstration blocks appear in every village today. Very little work has been done with regard to pruning ; this has been due to tea restriction and the resting of tea.

Green Manures.—I am glad to state that very little persuasion is necessary now in convincing the small-holder of the importance of growing green manures on their holdings. Everyone has realized the importance of having a good cover and makes every effort to grow it on their holdings.

Weather conditions have been fairly normal during the year.

Tea Restriction.—The second term of tea restriction has seen no changes and tea coupons still continue to be sold.

There was a big demand for tea during the last four months of the year and there was a sudden rise in the price paid for uncoupons tea from 40 to 50 cents per pound. The rise in prices and the demand for leaf continued till the end of the year. The price paid for tea coupons at the last issue was definitely low, the lowest paid for coupons for a very long time.

I recommend that reassessments should be granted to small-holdings in each year of the restriction period. This would definitely be a great encouragement towards better work and would help considerably in the improvement of small-holdings. In 1938, when reassessments were allowed, a great number took advantage of this opportunity and their holdings were reassessed. Since then small-holders have continued steadily to improve their holdings with the hope of a reassessment and it would be a pity to disallow this. My task would be made very difficult and the only opportunity small-holders would have of improving their holdings would be lost. They would have nothing to look forward to by carrying out my instructions. The majority of small-holders will not be prepared to spend their income from coupons if they are not to obtain some reward.

Bought-Leaf Factories.—These factories, which have been lying idle for the last few years, have once again started work, providing employment for much village labour.

General.—Three co-operative society meetings were attended in Uda-Palata, Yati-Nuwara and Uda-Bulathgama. I addressed them on "How to maintain and work small-holdings in Tea."

A special visit was made to Baddegama during the latter part of the year. It was for the purpose of helping in the preliminary judging at the competition held in this area. It was a very successful competition and small-holders are taking very readily to the new methods of work.

With bought-leaf factories starting work, there was a great demand for locally made tea chests. This too provided a good deal of employment in the villages. Albizzia was in great demand and small-holders had a ready sale for their trees at very high prices. This I hope will be an encouragement to grow more green manure.

Finally, I must thank everyone in these three divisions for the very willing manner in which they have co-operated in my work.

R. L. ILLANKOON,
Small-Holdings Officer

REPORT

OF

THE SMALL-HOLDINGS OFFICER.

BADDEGAMA, FOR 1939.

Small-Holdings Competition.—The year ended with the holding of a successful competition for the small-holders of the Keembiya Palata, Galle District, where intensive work was begun on November 1, 1938.

Out of 71 small-holdings classified as “progressive,” 30 were put up for the final judging which was carried out by the Director, Tea Research Institute and the Small-Holdings Advisory Officer, Gampola, on 6th, 7th and 8th December, 1939.

The prize-giving, presided over by the Director, Tea Research Institute, was held in the Keembiya Palata Government Mixed School, on December 9, 1939.

Three cash prizes, amounting to Rs. 50, and five certificates of merit were awarded to the successful competitors. The amount was made up as follows: Wanduramba Village Committee contribution Rs. 25; Tea Research Institute contribution Rs. 25.

Through the generosity of Mr. Amarasingha, the Chairman of this Village Committee, and the Vidane Arachchi of Keembiya Palata, the gathering was entertained to tea.

In addition to small-holders, the gathering included the following: the Mudaliyar of Gangaboda Pattu and the Headmen of Keembiya and Lelwala Palatas; the Chairman and the members of the Wanduramba Village Committee; the Superintendent of Gulugaha Kanda Group; the Agricultural Instructor, Galle; the Rubber Research Scheme Instructor for the area; the Head Teacher and the Staff of the School.

Copies of the Director's speech, printed in Sinhalese, were distributed to the small-holders present. These contained valuable advice under the following heads: 1 Pruning, 2 Use of lime, 3 Competition from other crops, 4 Cultivation, 5 Soil Protection. Under Head 5, reference was made to the use of *Gotukola* and fresh straw.

To all those who helped to make the function a success I tender my grateful thanks.

Work Done.—During the year visits as follows were paid to small-holdings and estates, the latter consisting of several small-holdings registered together.

First visits	...	...	432
Revisits	...	...	669
Visits to estates	...	...	77
Total—all visits	...	...	<u>1,178</u>

Circuits.—Revisits to the Keembiya Palata have now been arranged into 14 circuits, so that on the visits to the 71 “progressive” small-holdings, it is possible to keep in touch with the backward holdings also.

Field Equipment.—A canvas satchel, containing the field note book, copy of Ordinance No. 12 of 1938, pruning knife, and tipping knife, is carried to the field. A reverse-slope drain block, pruning saw, and an eette are also taken for demonstration purposes.

New Working Area.—Work was started in the new area, Lelwela Palata, during July, 1939. This appears to be a very backward area, needing much attention. After completing two village headmen’s divisions in this Palata, it has been possible to classify only 17 small-holdings as coming under the head “progressive.” It is hoped to complete the preliminary visits to the rest of this Palata, comprising Ihala and Pahala Lelwela, shortly.

Policy.—The policy of intensive work in a selected area, and treating each small-holder as a separate unit, has given encouraging results. This policy is being followed in the new area.

Plans for 1940.—The recent competition has stimulated interest in the adjoining Palata, and the preliminary steps in connection with the 1940 competition are being taken. In addition to the handbill, each small-holder is being issued with a printed Sinhalese translation of the Director’s speech made on December 9, 1939.

Pests and Diseases—have been observed as follows:—

Shot-hole borer	...	Small-holdings	...	9
	...	Estates	...	2
Red coffee borer	...	Small-holdings	...	2
	...	Estates	...	2
Ustulina root disease	...	Small-holdings	...	2

In each case advice was given according to instructions received from the Institute on specimens forwarded.

Pruning.—43 small-holders who were found doing their own pruning were taken in hand and instructed in the finer points of the operation.

During May as many small-holders as possible were induced to take advantage of the rains and get through their pruning. Revisits were paid to holdings where pruning had begun to ensure that the rim-lung method was properly understood.

Clean-pruning is still resorted to by the hired pruners. In some cases, where the owner had been previously instructed, the hired pruner's work was closely supervised. In the majority of cases, however, the pruning was given on contract, and the hired pruner allowed to have his own way. Subsequent visits were also paid to these holdings and instruction given in tipping and removal of the lungs.

Demonstrations.—54 demonstrations were carried out on different aspects of tea cultivation.

Green Manures.—Small-holdings now have the following shade and green manure trees: *Albizia*, *Grevillea*, *Gliricidia* and *Derris robusta*. Bush plants: *Crotalaria* and *Tephrosia candida*. Small-holders are being encouraged to grow *Gliricidia* in their boundaries also, thereby increasing the amount of green stuff available for forking in.

Cover Crops.—During June, 5,000 *Indigofera endecaphylla* cuttings were obtained from the Principal, Farm School, Peradeniya, free of cost, and issued to 13 small-holders, with necessary instructions.

In every case the cuttings struck fairly well. In some of the holdings it is spreading quite satisfactorily, while in others growth is slow. I wish to record my appreciation of the help given by the Principal, Farm School Peradeniya.

Weeding.—Most small-holders are inclined to neglect their weeding, and when a thick cover of grass is formed to use the mamoty. The importance of regular weeding has been stressed, and an effort made to popularize the eetie.

Drains.—The effectiveness of the reverse-slope type of drain has been shown, and several small-holders induced to convert their old drains to the new type. The importance of putting silt on the upper side of drains has been explained, and, wherever possible, small-holders have been persuaded to do this. Ways and means of holding up the soil there have been shown them.

Terracing.—Wherever stones are available, small-holders have been induced to extend their terracing. In a good many holdings it was found that a large percentage of bushes had their roots exposed. In such cases small-holders were induced to terrace the bushes on the lower side, in addition to the normal terracing.

Supplying.—The importance of this has now been realised and good progress made in this direction. The importance of low centering has been shown. Section 31 of Ordinance No. 12 of 1938, concerning filling of vacancies, has been explained.

Other Crops.—As a result of the advice given, small-holders are now realising the harmful effects of other crops on their tea. A tendency to remove these other crops is now noticeable. When there were rubber holdings adjoining, small-holders were persuaded to cut deep trenches to keep off the rubber roots.

Plucking.—The importance of careful plucking has been emphasized. In view of the better prices paid for green leaf the tendency to strip is bound to be great. The improvement in prices has resulted in much activity even in backward small-holdings. A new factory was opened in the Talgampola area towards the end of the year.

Compost.—Small-holders have been shown how to utilise all waste material for compost making. Several of them now have compost pits close to their holdings.

Use of Lime.—The practice of forking in lime was noticed and the matter taken up with the Institute. The advice obtained was conveyed to those concerned as well as other small-holders.

Appeals.—Ten small-holders successfully applied for special reassessment under Section 13 of Ordinance No. 12 of 1938. In the working areas small-holders have had their rights under the ordinance explained to them.

A Special Case.—(S.K. 337, 6 acres), situated in Talpe Pattu, is an example of an owner making full use of the advice given.

This holding when taken in hand on April 18, 1939 was in a very poor way. The owner started off with the improvements suggested, very methodically, and by July 1, 1939 the place was completely transformed.

Thirteen visits were paid to this holding during the year, and advice given and demonstrations carried out. The holding should now serve as a demonstration block to that particular area.

Other Areas.—Though intensive work is being done in a selected area, other places have not been forgotten. Work on a small scale has been carried out in the Four Gravets area, Talpe Pattu, Hinidum Pattu and Morawak Korale.

Attendance at Mudaliyars' division days, and addresses given, have enabled advice to be conveyed, through the village headmen, to most of the tea areas.

Division Days.—The chief headmen of all the tea areas in the Southern Province have been seen. At the division days attended, helpful addresses were given to the village headmen present. The fact that these chief headmen had previously been known to the writer has tended to make their co-operation very cordial. The condition of the holdings owned by the Vidane Arachchi of Lelwala Palata is evidence that these meetings have had good effect.

Meetings.—Group talks were arranged with small-holders on nine occasions. Keen interest was evinced by those present at these meetings. Their respective difficulties were gone into and helpful advice given.

On December 12, 1939 an invitation was received to preside at a "Food Drive" meeting to be held in the Keembiya Palata Government Mixed School. Arrangements for it had been made by the head teacher of the school.

The invitation was accepted, and on December 15, 1939 a suitable address was given to the large gathering present.

Peasant Allotments.—Visits to small-holdings in the Keembiya area during June took me through several peasant allotments. I was able to advise the allottees on draining, terracing and compost making.

The prize-giving at the Ampegama Peasant Colony was attended on March 29, 1939.

Special Visits.—During February a visit was paid to the Small-Holdings Department of the Rubber Research Scheme, Matugama. During April a visit was made to the Batapola Government Experimental Station. On both visits matters of mutual interest were discussed with the officers-in-charge.

Co-operative Societies.—Contact has been made with the seven Co-operative Societies in the Keembiya and the Lelwala Palatas. On May 7, 1939 I had the pleasure of being asked to preside at the Annual General Meeting of the Nathewela Co-operative Society. Most of the members of these societies are tea small-holders and these contacts are proving very helpful. The Divisional Assistant Registrar of Co-operative Societies, Colombo, Mr. S. B. Yatawara, was met on his last visit to this area.

Village Committees.—The Chairman and Members of the Wanduramba Village Committee continue to give good support. Lelwala Palata, the new working area, comes within the administrative limits of this Committee. Mr. W. Amarasingha, the Chairman of this Committee, has given me his whole-hearted co-operation.

A meeting of the Nagoda Village Committee was also attended.

Estates.—The superintendents of estates in the working area have been found always ready to help and particular thanks are due to the Superintendent of Walpita Group, Mr. T. Cunanayagam.

T. R. I. Conference.—The Conference was attended on both days, 13th and 14th February. The visit also enabled consultations to be had with the Director, Senior Staff, and the Small-Holdings Advisory Officer, Gampola.

Office.—The office records were initialled by the Director, Tea Research Institute during his visit in December, 1939.

Correspondence.—209 letters were received during the year and 390 sent out.

Visits by Senior Staff.—Visits were paid by Dr. T. Eden in March and the Director in December.

Quarters.—The Kondawatta Bungalow in Baddegama was engaged on October 15, 1938.

In closing I wish to thank the following for their hearty co-operation during the period under review: the Mudaliyar of Gangaboda Pattu, and the Village Headmen of Keembiya and Lelwala Palatas; the Chairman and Members of the Wanduramba Village Committee; the Nathewela Co-operative Society; the Superintendents of Walpita Group, Citrus Group, Nedunuyana Estate, and Gulugaha Kanda Group.

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